

Sandia scientist wins E.O. Lawrence award

Jack Jakowatz becomes sixth Sandian to win prestigious prize

By Neal Singer

Lab News Staff

Sandia scientist Charles "Jack" Jakowatz (5912) has been selected to receive a 1996 Ernest O. Lawrence Award, one of DOE's most distinguished prizes, for achievements that advance the use of synthetic aperture radar (SAR) to detect exceptionally small changes in landscape.

The technique is used to observe ground terrain from aircraft, through night and cloud cover, and can produce imagery with pixel size as small as one square foot.

The award — a gold medallion and \$15,000 — will be presented to Jack in Washington in April. Six other winners will also be honored. The work was funded by DOE's Office of Non-Proliferation and National Security.

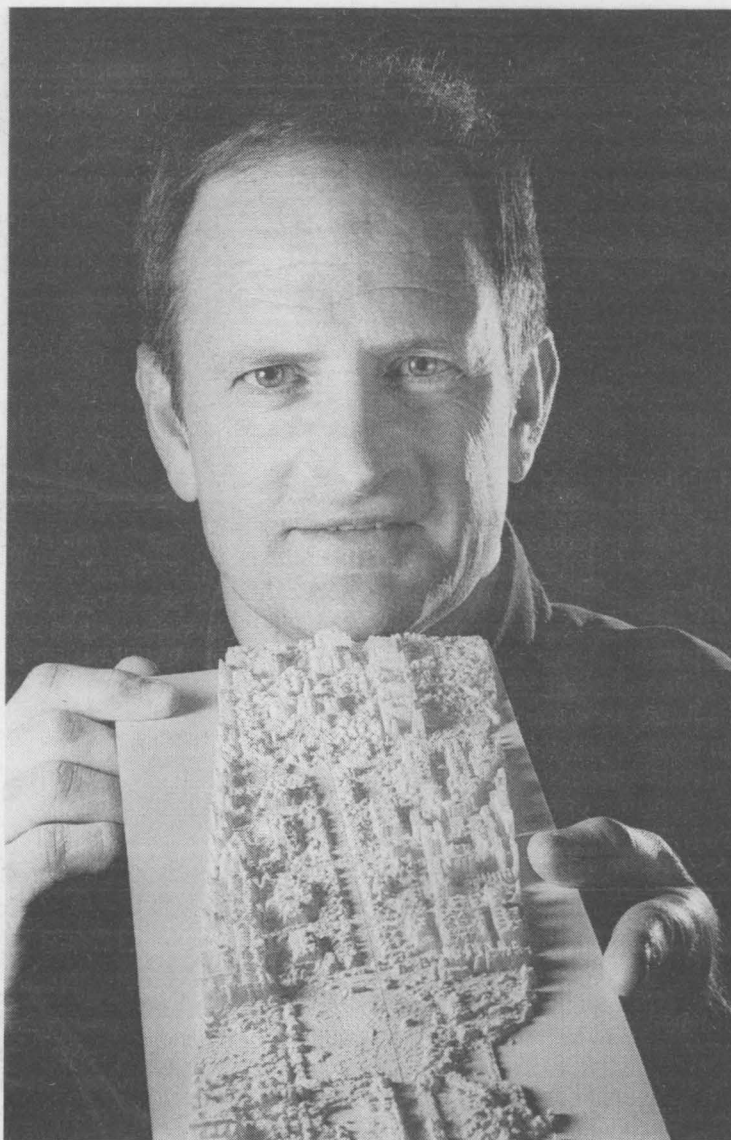
Better vision

Improvements in national security wrought by Jack and his colleagues have made it possible for arms control and treaty verification personnel to patrol by air the borders of formerly warring states and announce definitively whether military equipment has been brought in or removed.

A second closely related technique has been used to produce very accurate terrain elevation maps. The technique could be used by a satellite-borne SAR to create a geologic map in approximately six months that would describe the varying height of the entire earth to a few meters. The same technology has application to problems in geoscience as well, including the mapping of glacier motion and prediction of volcanic activity. The work could also improve the accuracy of military strikes.

A third branch of the research produced a method for automatically focusing SAR imagery unavoidably blurred due to unpredictable motions of the carrier aircraft.

The award is named for the inventor of the cyclotron — an early particle accelerator. E.O.



E.O. LAWRENCE AWARD WINNER Charles "Jack" Jakowatz holds a three-dimensional epoxy model of the Washington, D.C., mall area created from synthetic aperture radar data obtained at night from the air during heavy cloud cover. (Photo by Randy Montoya)

Lawrence directed one of the nation's first nuclear laboratories during World War II at the University of California at Berkeley. Two major laboratories

have been named after him: Lawrence Livermore National Laboratory and Lawrence Berkeley National Laboratory.

"I am both honored and flattered to receive this award," says Jack. "But I would like to make it clear that a single person doesn't make these contributions alone. I see this as an award for my many Sandia colleagues who together have done a tremendous amount of good work."

Plaudits

"His work is perhaps the most requested work by our VIP visitors and sponsors who come to visit," says Patricia Gingrich (5900), deputy director of Sandia's Systems Research Center. "They request a presentation from Jack. His work is very effective in providing information on national security. We're very proud of him."

Director David Nokes (5900), who was vacationing in Mexico, voicemail, "I am so thrilled for Jack."

Said Roger Hagenruber, VP for National Security Programs (5000), "It is a rare occasion when work not at the center of Sandia's priority mission in nuclear weapons engineering receives attention like this. There are many people who have contributed, but no single person whose contributions have been more seminal than Charles Jakowatz. I believe this is one of the finest examples of technical work I have ever come across at any laboratory. I believe we should be proud not only of Jack but of the environment that made this possible at Sandia."

How it works

The idea of using radar to image the ground has been around since the early 1950s, when the technique was used by pilots to produce generalized maps that showed coastlines and other large geographic features.

Radar works by sending out microwaves that bounce against objects. Those waves, captured in (Continued on page 4)

Most impacts resolved; executive management to consider remaining impacts Monday

The good news: Of the 448 positions that were impacted

as part of Sandia's Workforce Realignment Process in recent months, more than 95 percent have now been resolved through the Voluntary Separation Incentive Program (VSIP), internal transfers, special job postings, and other staffing mechanisms.

The possible bad news: If the remaining impacts aren't

resolved shortly, some individuals may be notified that they are "surplus," meaning they have 60 more days to find work elsewhere within Sandia or be laid off. It would be the first time since the Workforce Realignment Process was adopted in 1995 that Sandia has implemented Phase 3 of the process, the "60-day period for placement of surplus employees."

Staffing Department Manager Karen Gillings (3535) says for the second year in a row the VSIP package was instrumental in bringing the number of impacted positions down to a manageable level. So far this year, 344 of the impacts have been resolved as the result of employees voluntarily

(Continued on page 5)



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Sandia National Laboratories

Panel reviewing Sandia nuclear facilities following reactor incident, shutdown

A review panel consisting of Sandia nuclear reactor staff and management and outside expert consultants is at work reviewing operational and safety procedures, as well as nuclear facility support policies and management structure, at four key radiation research facilities in Technical Area 5 (TA-5).

The panel was convened following a Dec. 7 incident at the Annular Core Research Reactor (ACRR). Nuclear facility operations in Area 5 were suspended Feb. 3 for the review and are anticipated to resume in two to three weeks. The ACRR has not been operated since Dec. 18.

The goal of the review team is to identify

deficiencies and make recommendations for improvement at Sandia's reactor facilities. The affected facilities are the ACRR, Gamma Irradiation Facility, Sandia Pulse Reactor, and Hot Cell Facility. The panel will be chaired by Dr. Robert Seale of the University of Arizona, current Chairman of the Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards (ACRS). Other outside consultants on the review team include former Sandia and Los Alamos employees with extensive experience in reactor operations. The team will present its findings and recommendations to Executive VP John

(Continued on page 5)



3 New snow pack detector helps State of California predict spring runoffs

► Sandia's top 114 accomplishments of 1996 — See center pullout section

This & That

President to discuss provocative issues - Paul Robinson thanks all Sandians who suggested topics/questions for his next employee dialogue sessions Feb. 24-27. Several dozen of you sent suggestions, and Paul plans to cover some interesting and even controversial subjects. See separate story below this column about what he plans to discuss and the schedule. Mark your calendars and come hear what he has to say.

We'll soon miss our Mark - Lots of us have already said, or soon will be saying, good-bye to friends and colleagues who have decided to take the voluntary separation incentives and retire or work elsewhere. The *Lab News* is losing a fine employee and all-around good guy. Production manager/photographer Mark Poulsen will be leaving us March 13, moving with his wife Gerianne to Montana. (State motto: "Sure we're a little weird up here, but the country is beautiful!") Mark's joining his papa there in business. Mark, we're going to miss you, good buddy.

Fat Friday for Lab News - This is one of our rare larger-than-12-page issues. It includes our annual "Labs Accomplishments" special insert featuring Sandia's top accomplishments from FY96, solicited by the *Lab News* and selected by Sandia's management. We know Sandians made many more noteworthy accomplishments during FY96, but we must establish a reasonable limit, and the 115 or so is about the same number we publish each year. Thanks to all Sandians who submitted accomplishments, including those who didn't make the final cut. Putting this special section together is a true Sandia team effort, but Bill Murphy of the *Lab News* staff coordinated it from beginning to end - a major project - while keeping his regular stream of stories flowing. Thanks, Bill!

Consider filing these annual inserts as a permanent record of Sandia's top accomplishments. You can also find the FY94 and FY95 accomplishments on Sandia's Internal Web, on the Communications page, under Other Frequently Published News, Accomplishments and Awards; the FY96 accomplishments will be posted there soon. The Awards and Accomplishments page is also listed on Sandia's External Web at <http://www.sandia.gov/awards/a&aman.htm>.

Sandia souvenir sales help people - Retired *Lab News* Editor John Shunny, who keeps the *Lab News*, National Atomic Museum, and other Sandia groups stocked with Sandia logo souvenir items (mugs, caps, hats, golf shirts, tee-shirts) says 1996 sales totaled \$7,578. Every penny of "profit" from this "South 14 Village Project" goes to charitable causes, primarily to help needy folks living in six small villages south of Tijeras, N.M. More than \$3,400 was distributed in 1996, including \$100 each that John and fellow Sandia retiree Julian Sanchez distributed to 20 poor families in these villages just before Christmas. John notes that six single mothers who received \$100 each had a total of 15 children, including six foster children. A hundred-dollar bill doesn't go far these days, but it made the holiday season a little brighter for these folks. Thanks again, Sandians, for supporting another great cause.

- Larry Perrine (845-8511, MS 0129, lgperri@sandia.gov)

Congressmen laud Sandia/NIJ partnership

Calling attention to Sandia technologies that "have considerable usefulness in the law enforcement community," Rep. Steve Schiff (R-N.M.) lauded a newly formalized partnership between Sandia and the National Institute of Justice (NIJ) during a Jan. 30 announcement ceremony inside Tech Area 2.

As part of the one-year, \$500,000 agreement, Sandia will serve as an NIJ Satellite Facility (*Lab News*, Jan. 31), allowing the Labs to do research and development in support of state and local law enforcement and corrections agencies, including quick-response evaluations of new and existing criminal justice technologies. Sandia has worked with the NIJ informally since 1992, evaluating such technologies as sticky foam, aqueous foam, and a safe gun. The new agreement formalizes the partnership; Debbie Spencer (5861) is the program manager.

During the ceremony, David Boyd, Director of the NIJ's Office and Science and Technology, noted Sandia's work in 1995 evaluating a plastic hand-held device billed by its manufacturers as capable of detecting "atomic emissions" from narcotics, explosives, and lost golf balls. More than 1,000 of the "Quadro Trackers" had already been sold to unsuspecting school administrations and law enforcement agencies, but Sandia's evaluation showed that the devices had no internal components, he said.

"The US has had no central R&D capability to support our national law enforcement community [as have] the medical and defense communities," Boyd said. "This partnership will make available technical capabilities that we could not conceivably have afforded in the next ten years or more."

Representatives from the offices of Sen. Pete Domenici and Sen. Jeff Bingaman read letters of support for the partnership as well.

After the presentations, attending dignitaries and news media representatives were treated to demonstrations of two new Sandia technologies: the bomb-disabling "black box" (developed by Engineering Projects and Explosives Applications Dept. 9333), and a walk-through portal for detecting trace quantities of explosives on airline passengers (developed by Contraband Detection Technologies Dept. 5848).

Also attending the event were Jim Keller, Director of the NIJ's National Law Enforcement and Corrections Technology Center; Albuquerque Police Department Deputy Chief of Police Sal Baragiola; FBI Special Agent Steve Schlobohm; and Labs Director C. Paul Robinson and Deputy Director John Crawford. —John German

Provocative, tough issues to be discussed at Feb. 24-27 employee dialogue sessions

Why aren't Sandia's pension benefits going up? What are we doing about poor performers and poor managers? Are we getting more complicated, and how can we "fix the system?" If we're really cutting overhead costs, why are our rates going up?

Sandia LabNews

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LOCKHEED MARTIN

These are some of the questions that Labs Director and President Paul Robinson will discuss at his next set of employee dialogue sessions Feb. 24-27.

Several other subjects Paul plans to cover:

- What kind of lab will Sandia be in 10 to 15 years, and will we still build hardware?
- What kind of energy work will we be doing?
- Will DOE survive, and what will the Federico Peña appointment mean?

• What's the status of our Voluntary Separation Incentive Program (VSIP), and will we have one every year?

• Why are there so many internal barriers that get in our way of doing our work?

These questions and subjects were all suggested by Sandians as a result of *Lab News* and *Weekly Bulletin* solicitations. Paul says he wants to talk about the subjects that employees truly want to hear about and will answer other employee questions asked at the sessions.

Some recent Sandia accomplishments will also be featured in a creative and entertaining tape from Video Services Dept. 12610.

Please join Paul and your colleagues at one of these sessions:

- Monday, Feb. 24, 3-4 p.m., BDM Bldg.
- Wednesday, Feb. 26, 8:30-9:30 and 10-11 a.m., Technology Transfer Center (Bldg. 825)
- Thursday, Feb. 27, 8:30-9:30 and 10-11 a.m., Bldg. 904 Auditorium at Sandia/California

Video Services to host open house Feb. 19

Video Services Dept. 12610 invites employees to tour its new production facilities in Bldg. 892, Suite 101, during an open house on Wednesday, Feb. 19, any time between 9 a.m. and 1 p.m. See what it takes to put a video together. The open house includes hands-on demonstrations and refreshments. For more information, call Debbie Johnson at 844-3570.

Take Note

Retired Gen. Colin Powell is scheduled give the keynote address at the Quality New Mexico Conference at the Albuquerque Convention Center on Thursday, March 6, at 10 a.m. Tickets for the keynote address cost \$50 and \$65 and may be purchased through Protix at 1-800-905-3315. Registration for the entire conference, March 6-7, including Powell's address, is \$345. Contact the Quality New Mexico Office at 797-8978 to register. Lockheed Martin Corporation is cosponsoring the conference.

Retiring and not seen in *Lab News* pictures: Moreyn Cole (7578), 27 years; Janell Crego (12830), 16 years; Russell Curtis (7400), 21 years; William Drozdick (9709), 35 years; Thomas Evans (14303), 34 years; Barbara Frederickson (4913), 16 years; Charles Karnes (7511), 33 years; and Barbara Ann Merriken (5706), 16 years.

Snow melt forecasts go 'back to the future' with Sandia prototype sensor

Small automated device could substitute for unwieldy apparatus

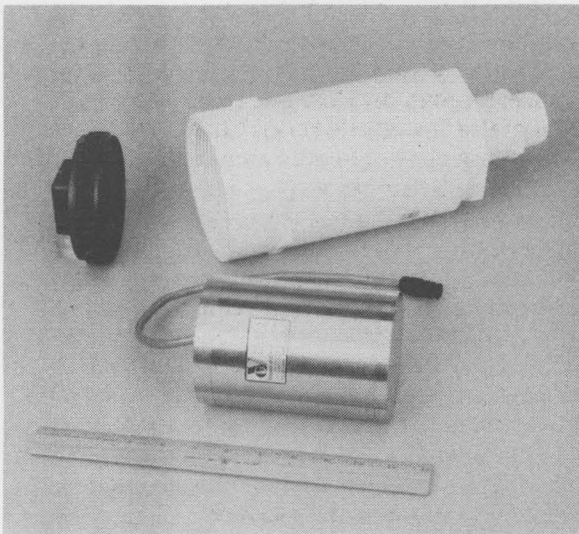
By Nancy Garcia

California Reporter

Since 1911, the State of California has surveyed snow in the Sierra to predict runoff and estimate water supply.

The measurements help growers plan what and how much to plant, reservoir managers decide how much space to leave for flood control, forestry officials predict fire danger, and hydropower generators anticipate operation schedules.

However, measuring snow packs of 10 feet or more on isolated mountain slopes can be arduous.



COMPACT — The prototype sensor and housing are about the size of a coffee can.

About 100 snow survey sites are equipped with bulky automated systems, which in designated wilderness areas must be hauled in by pack mules. In addition to this approach, the most accurate measurements are taken manually at about 300 sites several times a season. Surveyors trek in by ski, helicopter, or Sno-Cat to push a sharp-edged, hollow tube through the snow and weigh the contents.

An alternate, easily portable device is under development by Sandia and the California Department of Water Resources. These ground-based automated sensors, each about the size of a coffee can, detect how snow shields the sensor (and therefore the ground) from some degree of cosmic radiation. Water attenuates this radiation, and the degree of attenuation indicates how much water is present in the snow pack.

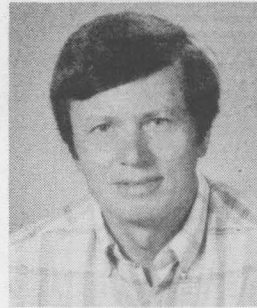
A ski trip brainchild

The idea was the brainchild of electrical engineer Ken Condreva, who works in Telemetry and Digital Signal Processing Dept. 8416. Ken met some snow surveyors on a cross-country ski trip and later realized that elements of his current project (radiation detectors, microelectronics) could be used to automate snow surveying. Ken then originated the automated system, tested it in a co-worker's swimming pool, and began a collaboration with Frank Gehrke, chief of the California Cooperative Snow Surveys unit of the Department of Water Resources, Division of Flood Management.

"We've almost gone full circle," Gehrke says. "Since as early as the 1950s, the US Corps of Engineers had a series of snow-sensing devices that detected attenuation of a radioactive source, perhaps cobalt 60." Nowadays, surveyors would not introduce a radioactive source into the environment, but rather detect the natural cosmic radiation.

Despite flooding this winter, the snow pack has been near normal in the Northern Sierra and

above normal in the South and Central Sierra, Gehrke says. The deluge damaged operation of four previously installed automated devices.



KEN CONDREVA

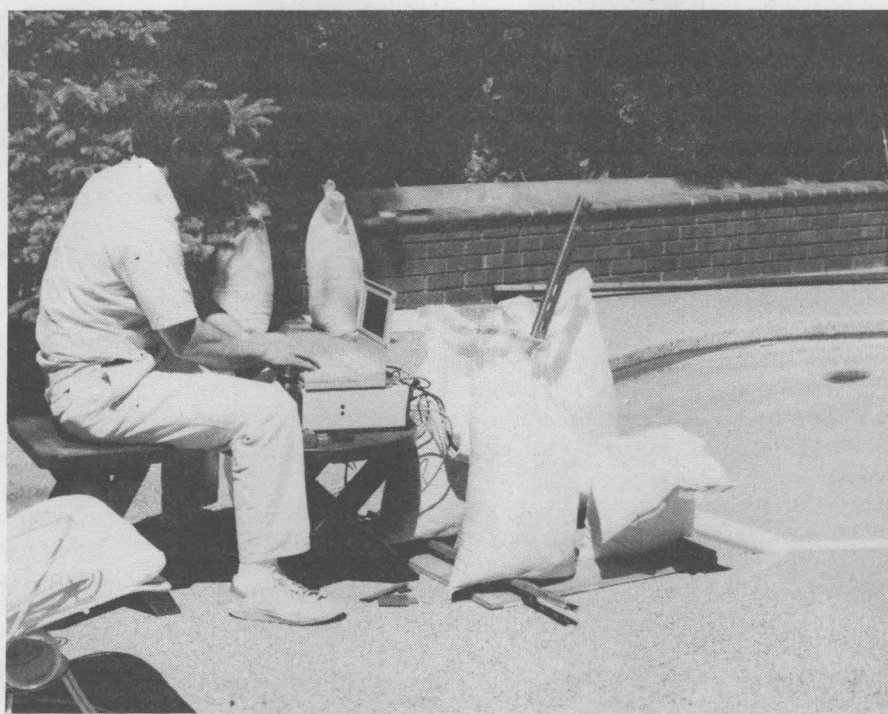
These existing devices are called "snow pillows." Measuring an inch-and-a-half thick, they are four feet by five feet on the sides and resemble enormous, stainless-steel water bottles. Inside is a freeze-resistant alcohol solution that is benign enough to also be used in hair spray. The fluid registers the growing snow pack by signaling a battery-operated pressure transducer. An 80-square-foot rectangular array of four snow pillows on a flat, well-drained site is necessary to adequately measure the snow pack, Gehrke says.

This existing system is susceptible not only to water damage, he said, but also to vandalism by animals and humans. The fluid, propylene glycol, must be hauled in, and transporting the pillows themselves is "quite frequently a logistical nightmare," he says. Consequently, surveyors everywhere are interested in alternatives to the current technology.

Installed near the Donner Summit

Sandia's prototype, patented sensor was installed last February at the Central Sierra Snow Laboratory. The study site is at an elevation of 6,883 feet in Soda Springs, Calif., near the Donner Summit off Highway 80. Manual samples taken periodically around the sensor indicated it was tracking the snow pack accurately.

This year, the sensor will be tested for an entire season. The researchers will try varying the length of time they collect a signal and will develop an interface with a data-collection platform. The plat-



SPLASH — Ken Condreva initially tested the snow pack water sensor in a friend's swimming pool.

form transmits data to NASA's GOES satellite, which rebroadcasts the measurements in near real-time to the surveys unit.

During the summer, Gehrke worked with researchers at Scripps Institution of Oceanography to calibrate the device. They immersed it in 20 feet of water in San Vicente Reservoir — equivalent to about 60 feet of snow, more than ever expected at the survey sites — and were able to still receive a very detectable signal.

Snow Surveys has a home page on the World Wide Web (<http://snow.water.ca.gov>) and has received inquiries about up-to-date survey tech-



RECORD RECORDING — A surveyor digs out a "snow pillow" at the snow lab in June 1995. The 80-square-foot pressure detector bore 33 tons of snow in a late-melting accumulation that measured more than twice the normal amount.

Sandia California News

niques from such far-flung places as Turkey, New Zealand, and Finland.

"What Ken is developing I think has the most promise," Gehrke says.

Compact, affordable

The Sandia system is not only easily transportable; the device should also be affordable.

The snow pillows and a transducer cost about \$2,800 per site, while the prototype detector system costs about \$3,500. There are potential worldwide applications; Gehrke believes the manufacturing cost would go down if the system were produced in volume.

Forecasts vital for planning

In California, the snow pack usually peaks in April and melts away by about July, providing much-needed runoff during the state's dry season. Forecasts are published monthly from February through May. The information indicates many things: how rivers should react, what percentage of electrical power must be generated by steam (produced by fossil fuel or nuclear reactors) instead of hydropower, future fishery releases, irrigation schedules and ground water pumping needs, and which rivers should offer the best rafting.

The Department of Water Resources is within the California Resources Agency, which has final responsibility for runoff forecasting

in the state. Snow surveys were first conducted in California to settle water rights disputes in the Lake Tahoe basin shortly after the turn of the century. Elsewhere in the United States, the Natural Resource Conservation Service provides equivalent forecasts.

★ Congratulations

Congratulations to Barbara Troen (8802) on the adoption of Megan Kelly, Jan. 13, born Oct. 1, 1994.

Lawrence award

(Continued from page 1)

reflection by an antenna, can be used to construct images of what's out there.

The problem was that an aircraft at great height could produce only a coarse image of ground features, because resolution was dependent on the antenna's length. This arrangement, called SLAR (Side-Looking Airborne Radar) proved impractical because finer image definition depended on lengthening the antenna to an unwieldy degree.

Synthetic aperture radar (SAR) advanced a different concept. SAR uses a short antenna but transmits and receives many radar pulses as the

airplane moves forward. These radar echoes are then integrated by signal processing techniques to synthesize an image of the same resolution as one that could be obtained by using an antenna as long as the flight path. This flight path is dubbed the "synthetic aperture."

"The problem is that for the synthesis process to succeed, you have to know the position of the aircraft to a fraction of a wavelength — in this case, a fraction of a centimeter — each time it fires a pulse, and it fires on the order of 1,000 pulses a second," says Jack.

Although modern electronic navigation technology is good at determining aircraft position, the high resolution of modern SAR means blurring can occur from small unplanned movements of the plane — the result of varying air currents or other forces. One of the results of the Sandia

Five Sandians have won earlier Lawrence awards

Recipients of the E.O. Lawrence award, presented since 1960, have included some fabled names in science, including Richard Feynman, Louis Rosen, and Sidney Drell. Five Sandians have won previously: Pace VanDevender, Tom Picraux (1100), Gordon Osbourn (1155), Gus Simmons, and Tom Cook.

research has provided a robust solution to this image-resolution problem.

Improvements by Jakowatz team

In three significant improvements, Jack and his colleagues:

- In 1989 patented a means to remove image blurring caused by the bouncing of the plane as it traveled through the atmosphere. "We invented a technique that started with an out-of-focus image and could derive from that image the motion of the plane that was producing defocusing. Then the technique backed out that error and left behind the clear picture," says Jack.

- In the early 90s, learned to process images of the same patch of earth taken in pairs, separated in time by days or weeks. "Using a procedure that detects changes in the images, we learned how to measure very subtle disturbances on the Earth's surface. This can be of great value in arms control verification problems."

- In the mid-90s, learned to create a three-dimensional SAR product by comparing images taken in pairs from slightly different locations. Using signal-processing techniques, these image pairs can be combined into an interference fringe pattern, just as an ocean wave penetrating a sea wall at two points forms two sets of waves that alternately reinforce and quell each other. By analyzing aspects of the interference pattern, very precise terrain elevation information may be extracted.

"With this method, we can compute the elevation of the earth's surface to a fraction of a foot," says Jack. In another model, the method can detect motion of the earth's surface in the time between two SAR collections. The ability opens the possibility of monitoring ground fault slippage to predict earthquakes and monitoring the ground swell that normally precedes volcanic eruptions to warn of impending eruptions.

"Flood plain management becomes simpler if you can map a river valley and know accurately the elevation of the earth at any point, thereby knowing precisely where the water's going to go. Even a one-foot change in elevation can be important in selecting the location of a dam."

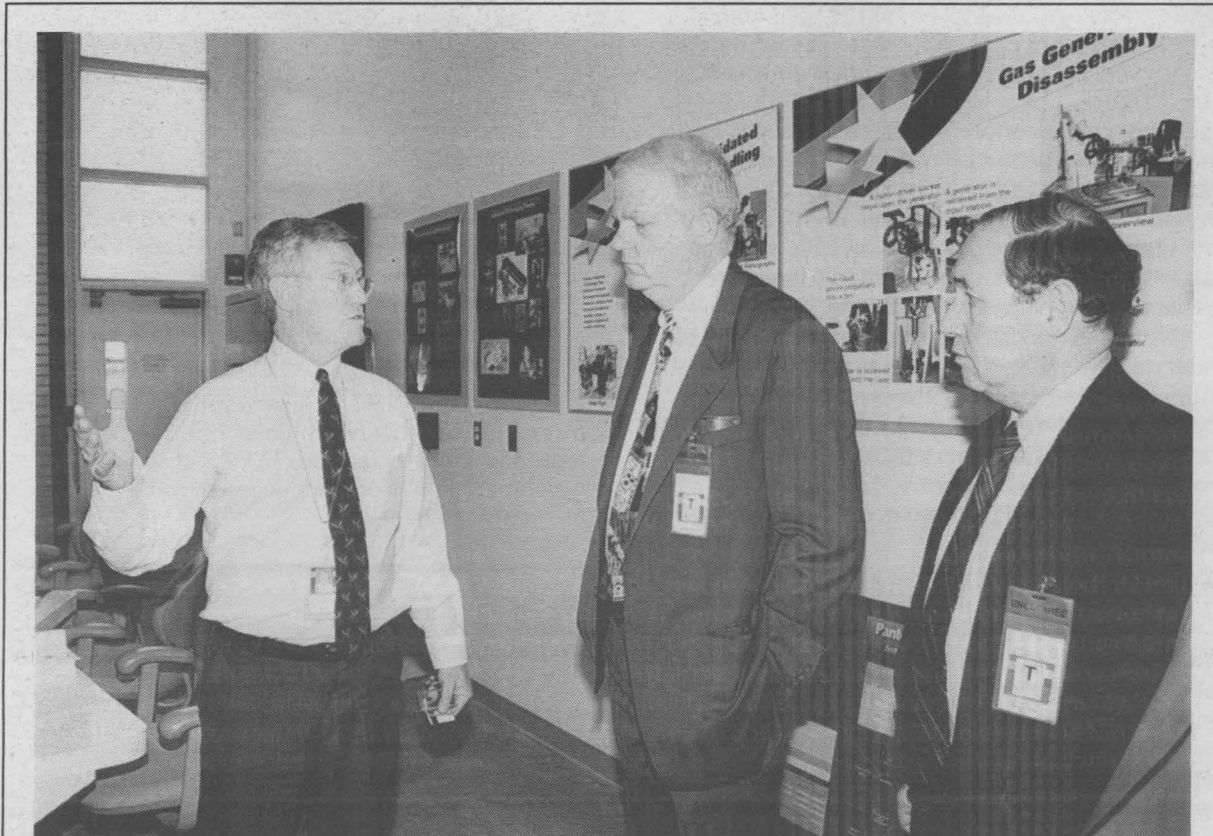
With SAR three-dimensional reconstructions, Sandia's Advanced Manufacturing Center used stereo lithography to create a three-dimensional epoxy model of the Washington, D.C., mall area. Data was obtained from the air at night when the city was under heavy cloud cover.

In 1996 Jack and colleagues Dan Wahl (5912), Paul Eichel (2524), Dennis Ghiglia (9222), and Paul Thompson (5912) published a book, *Spotlight-Mode Synthetic Aperture Radar: A Signal Processing Approach*. The book, already in its second printing, was written "in the spirit of general scientific exchange, and as part of the mission of the DOE to share unclassified technology," says Jack, who says he is grateful to Sandia management "for fostering the kind of environment where this kind of research can be conducted."

CAT scans to earth scans

Jack came by his interest in airborne microwave imagery from down-to-earth medical work on CAT scans at Purdue University as a graduate student. "I was fascinated that the same mathematical concepts employed to image the human brain using X-ray data taken from a series of positions surrounding the skull in computerized tomography could also be applied to a series of microwave bursts bouncing off the ground."

Jack did all his college work at Purdue, receiving a bachelor's degree in 1972, a master's in 1973, and a doctorate in 1976, all in electrical engineering.



SCIENCE CHAIRMAN — The chairman of the House Science Committee, Rep. Jim Sensenbrenner, Jr. (R-Wis.), center, gets a briefing at Sandia's Robotic Manufacturing Science and Engineering Laboratory from Pat Eicker (9600), left. He was accompanied by Rep. Steve Schiff (D-N.M.), right. Sensenbrenner's Jan. 27 visit to Sandia also included a visit to the Cooperative Monitoring Center and lunch with Sandia President C. Paul Robinson and Executive VP John Crawford.

Around the corporation **LOCKHEED MARTIN**

VentureStar key to economic development of space

Lockheed Martin's reusable launch vehicle VentureStar will reduce the cost of flying into space, which is the key to development of what during the 20th century has been called the "final frontier," Lockheed Martin Aeronautics Sector President James 'Micky' Blackwell told a Space Technology & Applications International Forum audience in Albuquerque Jan. 27.

"With VentureStar, our purpose is clear — we want to revolutionize the space launch market by dramatically reducing the cost of going to space all the way down to \$300 per pound," Blackwell said. "That would be a real breakthrough, the kind of revolution that makes entrepreneurs and investors alike sit up and take notice. Fifty years ago, Chuck Yeager broke the sound barrier. With VentureStar, we're going to break the cost barrier."

And breaking that barrier will unleash "the creativity of 21st century entrepreneurs around the world," he said, generating new products and new services that will spawn new businesses and new jobs.

Blackwell compared the dawn of reusable space vehicles to the development of flight itself, which transitioned from the Wright brothers' stunning flight at Kitty Hawk in 1903 to the founding of companies to build aircraft and aircraft parts to airlines carrying passengers and cargo to the global businesses of today that depend on fast transportation.

"Not so long ago, that seemed as far-fetched as the airplane itself," he said. "Today, we can't imagine living without it. That's the kind of innovation and business growth VentureStar will make possible."

Blackwell took advantage of his trip to visit Sandia, getting a tour of the Robotic Manufacturing Science and Engineering Laboratory from Pat Eicker, Director of Intelligent Systems and Robotics Center 9600, and a briefing on synthetic aperture radar/automated target recognition by Rick Fellerhoff, Manager of Aided Navigation & Remote Sensing Dept. 2525, and Jack Jakowatz, Manager of Analysis Dept. II 5912.

★ Congratulations

To Wendy (6523) and John (5722) Falls, a son, Justin Conner, Nov. 16.

To Annette and Kevin (6643) Seager, a son, Cole Brendan, Dec. 15.

To Pamela Ramsey (10501) and Bryan Spicer (2615), married in Albuquerque, Jan. 18.

To Janet and Chuck (6216) Andraka, a son, Samuel Paul, Jan. 23.

☀ Recent Patents

Gregory Frye, Kent Pfeifer (both 1315), and Thomas Schneider: Acoustic Wave (AW)-based Moisture Sensor for Use with Corrosive Gases.

Robert Anderson (1841): Modular Architecture for Robotics and Teleoperation.



Realignment

(Continued from page 1)

resigning with VSIP benefits. Internal transfers and other staffing solutions together have accounted for an additional 77 resolutions. The following chart shows the latest numbers of approved VSIPs:

	NM	CA	Total
Impacted	254	35	289
Nonimpacted	52	3	55
TOTAL	306	38	344

What's next?

Last Friday (Feb. 7), VPs who had impacts remaining in their divisions submitted to Human Resources the results of "paired comparisons" of employees in impacted peer groups, including the names of individuals who may be surplus. (See "How a paired comparison works" at right.)

This week, Sandia's Review Board considered these names on a case-by-case basis to ensure that the realignment process so far has treated each employee fairly and that all realignment possibilities have been explored for each person, says Karen. Each VP was asked to defend why he or she is recommending the person or persons be surplus. The Review Board, chaired by Human Resources Director Don Blanton (3500), includes the Diversity director, two technical line directors, and the Staffing manager with counsel from Legal and Equal Employment Opportunity/Affirmative Action representatives.

On Monday (Feb. 17), the final list of Review Board-approved names is to be presented to Sandia's executive-level Realignment Board during a Sandia Quality Leadership Council meeting. The VPs then will consider the remaining impacts, exhaust any further inter-organizational realignment possibilities, and make a final determination about which employees, if any, are to be surplus.

Even if some employees are declared surplus,

How a paired comparison works

In a paired comparison matrix, the name of each employee in a particular peer group is listed alongside each of eight professional attributes: 1) job knowledge; 2) transferability of skills; 3) overall performance; 4) work practices; 5) teamwork; 6) customer focus and satisfaction; 7) integrity, ethics, and respect for the individual; and 8) a wild card category defined by the comparing organization.

Each attribute for each employee is then compared to each colleague's corresponding attributes and a numerical rating is assigned to each comparison.

If a paired comparison is conducted for fictional employees Joe, Mary, and Sam, for instance, each of Joe's eight professional attributes is compared with each of Mary's corresponding attributes and then with each of Sam's corresponding attributes. Joe might

be more punctual than Mary, so Joe's "work practices" score might be higher. Mary might know her job better than Joe, so their "job knowledge" scores would reflect that, and so on.

When the matrix for the entire peer group is complete, an overall score can be summed for each employee. The employee or employees who score lowest in the matrix will be declared surplus if the Review Board and Realignment Board agree with the paired comparison and no other resolutions can be found. The number of employees who are declared surplus depends on the number of impacts remaining in that peer group.

Typically, a paired comparison is conducted by a center director and a group of department managers who are familiar with the work of the people being compared.

says Karen, layoffs aren't necessarily a given. "Phase 3 is when all of Sandia's resources are brought to bear on resolving our most difficult staffing problems," she says. "It's difficult to speculate what the final outcome might be, but executive management remains committed to Sandia's goal of resolving all impacts voluntarily to the extent possible. Everyone wants a positive outcome."

60 more days

Human Resources VP Charlie Emery (3000), who chairs the Realignment Board, says the meeting will make all the VPs aware of each other's remaining impacts, which may help them identify a few additional cross-divisional resolutions in coming weeks. During last year's successful realignment, he says, the VPs did identify a few last-minute resolutions by looking at Sandia's remaining staffing problems from an overall, Labs-wide perspective.

"It sheds a broader light on the problem," he says. "Our hope and goal is to get to zero impacts without surplus anyone."

The Realignment Board will look at several alternatives for the remaining impacted employees: whether some employees' skills could be mapped to other existing jobs within the Labs, whether additional training could allow some employees to be transferred, whether some work might be shifted across division boundaries, or whether employees who can't be placed will be declared surplus.

If some surpluses are necessary, those employees are expected to be notified by the end of February. Employees who are members of impacted peer groups have been notified throughout the process when resolutions negate their impacted status.

The *Lab News* and *Sandia Daily News* will continue to cover realignment-related developments as they occur. —John German

ACRR incident

(Continued from page 1)

Crawford.

The ACRR incident, which posed no threat to the safety of workers or the environment, involved violations of procedures and reporting requirements. The actions of the employees involved were evaluated by Sandia management and the Disciplinary Review Committee, resulting in disciplinary actions.

During a test at the ACRR in December, the automated plant protection system shut down the reactor after operator inattention caused the power to rise above the currently authorized two megawatts operating power to the 2.2 megawatts scram (automatic shutdown) point. The ACRR can operate as high as four megawatts. Thus, no safety limits were approached.

The employees failed to log or report the automatic shutdown system action, however, as required by nuclear facility operating regulations. Management learned of the event 10 days later, and ACRR operations were immediately suspended at that time until further investigations could be completed. A formal safety report was filed, and DOE was notified of the event.

"Policies and procedures for nuclear facilities are carefully developed to ensure the safety of the staff, the facility, and the environment," said Paul Pickard (9360), Deputy Director for Tech Area 5. "As we have analyzed the ACRR incident, we concluded a prudent action was to suspend all Area 5 nuclear operations pending a thorough review of procedures," Paul said. "We want to ensure that none of the problems identified in that incident could occur in our other nuclear facilities."

The incident posed no threat to the safety of workers or the environment.

Last September Sandia was named by DOE as the US production facility for molybdenum-99 (Mo-99), the primary radioisotope used in nuclear medicine. The ACRR and Hot Cell Facility are to be used for the production of the radioisotope and were instrumental in recent successful demonstration of the generation of high-quality Mo-99 that met medical-use standards.

Review and evaluation of TA-5 facilities will include consideration of the issues involved in the transition from traditional defense programs work to medical isotope production and research.

With the facilities in the midst of this transition, Dick Coats (9360), medical radioisotopes program manager, said the pause in operations is timely. "We need to take a close look at the operating procedures, safety attitudes, and management structure as we transition to this new mode of operation," says Dick. "The strict emphasis we have traditionally placed on safety needs to be maintained and valued in the new line of work, also."

Historically, R&D weapons-related experiments at the ACRR and Hot Cell Facility have been conducted on an intermittent basis dependent on the schedule of the experiment program. The change to production will mean a focus on only one operation and will require running the ACRR for up to 24 hours per day.

"Both the repetitive nature of the work and continuous reactor operations will present new challenges to the approximately 50 staff on the Mo-99 project," says Dick.

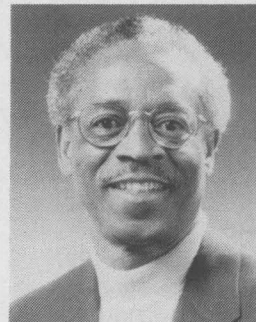
Changes in work at the ACRR and Hot Cell Facility also will require a stronger emphasis on product reliability and an understanding of the requirements of production. In addition to the many federal laws, DOE orders, and Sandia regulations already heeded, additional federal laws and the Good Manufacturing Practices (GMP) associated with the Food and Drug Administration must also be adhered to.

Limited Mo-99 production is anticipated to begin this year. —Kathy Kuhlmann

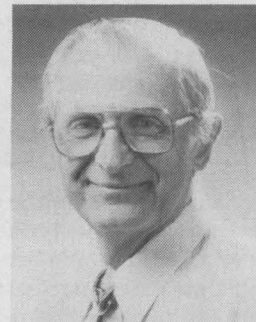
Retirement open houses

Sandia is hosting open houses in honor of the following retirees: **William Drozdick** (9709) on Wednesday, Feb. 5, 2:30-4:30 p.m., in the Area 1 Cafeteria (Bldg. 861); **Robert Cranfill** (5512) on Thursday, Feb. 6, 5-7 p.m., in the Coronado Club Zia Room; **Eli Perea** (2643) on Friday, Feb. 7, 5-7 p.m., in the Coronado Club Zia Room; and **John Portlock** (5901) on Thursday, Feb. 13, 2-4 p.m., in the Area 1 Cafeteria (Bldg. 861). Refreshments will be served. Friends and acquaintances are invited.

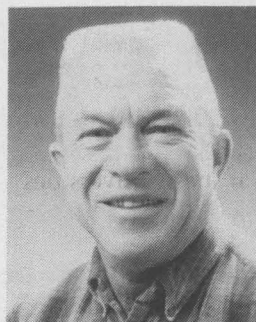
Recent Retirees



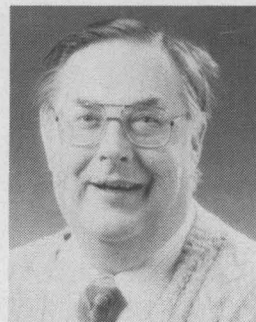
Hugh Jones 25
10221



Charlie Zaffery 35
5711



Lynn Loveland 20
9732



John Portlock 33
5901



Labs employees get advance glimpse of new job classification system to take effect later this year

Integrated job structure will affect MLS, MTS, and TA classifications

By Ken Frazier

Lab News Editor

Employees who attended a series of near-capacity briefings last week got their first look at the new job classification structure that will be implemented in July.

The goal of the briefings was to give employees some early general information.

"We wanted to give you an overview, so when you have conversations with your manager later in the spring, you'll have some idea what's going on," said Ed Cassidy, Manager of Compensation and Job Evaluation Dept. 3545.

Goals of the new Integrated Job Structure (IJS) are to provide fair and equitable classification of employees doing the same work, similar personnel practices for all employees, a stronger link of pay to the external marketplace, straightforward classification criteria, an easier ability to move to different jobs within the Labs, and multiple career paths.

Training to begin

Managers in some groups will begin training in the new system within the month. This year's round of performance/compensation review, however, will continue under the present system.

The new structure, when activated, will affect all technical, technician, and laboratory-staff employees and their managers. Administrative staff associates (ASAs) and union-represented employees are not part of the new structure, but Ed said a team will review the ASA classification later this summer for possible inclusion in the IJS.

A combined team of technical, technician, and administrative staff employees have been working on the design of the IJS for more than two years. Nearly 2,400 Sandians responded to questionnaires about it. There have been three town meetings, six focus groups, a series of *Lab News* articles (Nov. 10, 1995, and April 12 and Sept. 13, 1996), and a pilot test with 150 managers and 1,000 employees. The latter identified a number of issues.

The team integrated the input from all of these sources into the final design.

"In my 30 years here, never have we done an employee classification that had so much employee input," said Ed.

Multiple paths, room for growth

Sandia President and Laboratory Director C. Paul Robinson spoke in a video about the new structure. "It's time to get serious about multiple career paths," Paul said, referring to one of the executive requirements for the system. The structure provides several career ladders and parallel routes for advancement. "It's

also time to get rid of pigeon-holing," Paul said, where people get stuck in one job. The new structure has a floor "but does not box you in." It also addresses the problem of employees in different classifications doing the same job.

"We're really proud of the output," he said. "It's person-based rather than just job based."

Paul continued with an admonition to managers. "The big question now is, will it be successfully implemented?" That, he said, "is in your hands." He noted that the new system will require judgment on the part of managers — not to overclassify or underclassify employees. And he had more advice for them: "People resent change done to them." He said open communication will be the best tool for ensuring everyone understands what's being done.

Some specifics

Here are a few specifics of the IJS. Further details will be provided via manager training in coming months, but as of last week most of the information is now available to employees on the IJS Home Page. From the Sandia Internal Web home page click on the IJS icon.

The structure has these basic elements:

- Career ladders — Technical Staff, Laboratory Staff, Technologist — with four levels on each ladder: I, II, Principal, and Distinguished (see chart). In addition, the structure defines the Management ladder, including Team Supervisors.

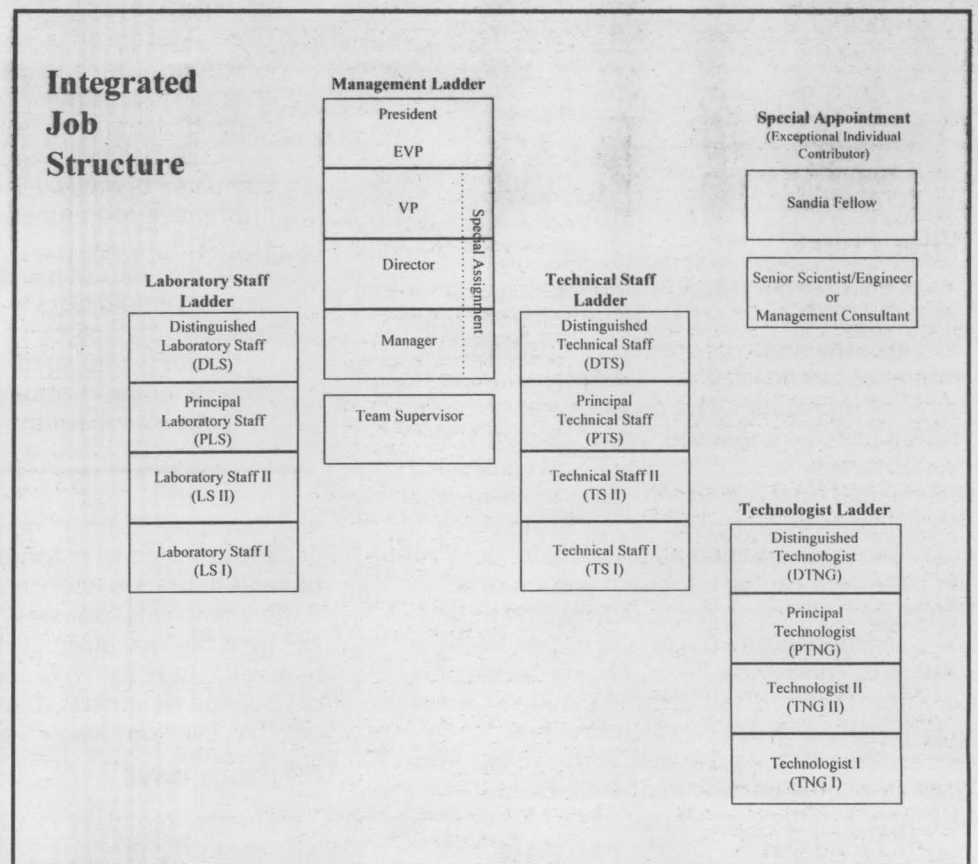
- Level charts with four or five competencies for each level (all must be met). Examples:

For Technical Staff: Nature of work and technical expertise; exercise discretion/direction received; creativity; responsibility for external contacts; sphere of influence/potential impact on organizations

For Laboratory Staff: Nature of work; skill/job knowledge; operational latitude; responsibility for contacts; impact of actions/decisions

Technologists: Nature of work; discretion exercised/direction received; creativity; impact of work and sphere of influence

(For each competency and each level, there are detailed level criteria — skills, knowledge, and abilities that describe the floor criteria between job levels. These are not shown in this



brief summary but are available on the Web. Managers are to use these level criteria to classify their employees appropriately.)

- Occupations: A list of about 150 occupations (broad, market-driven categories of work) that can be matched wherever possible to the external market (examples: accounting, business planning, computer software support, electrical/electronic engineering, physics, records management, systems project engineering). Descriptions of each are available at the Web site. People with a variety of different academic backgrounds can have the same occupation.

A spelled-out system

"Basically," said Ed Cassidy, "for the first time in Sandia's history, the criteria for whatever level you're in will be spelled out for everyone to see. This is a better system."

Each career level has a salary band. Employees can be paid anywhere in the salary band for their level, regardless of their occupation. Ed emphasized that there is a lot of overlap in the salary bands and that the bands are quite broad.

The new system, Ed said, better fits the modern business environment in which organizational hierarchies are flatter than they used to be. More and more, he said, "careers will be horizontal rather than vertical. Any one of these levels can be a career level."

"The drivers for placement are the level charts and occupations," he said, "not the salary bands."

A few other points:

- Managers, in consultation with their employees, will have responsibility for classifying each employee according to the level criteria and occupation descriptions. Those meetings and actions will take place from February to the beginning of June.

- No stigma is attached to movement between ladders. The system is designed to allow employees to bid on any job for which they feel themselves qualified, and it allows managers to put "the right person in the right job at the right time" without bureaucratic barriers.

- There will be no automatic salary change as a result of moving between the Technical Staff and Laboratory Staff ladders.

The *Lab News* will continue to report more details on the Integrated Job Structure as implementation progresses.

Some frequently asked questions about the IJS

Here are answers (provided by Ed Cassidy) to some frequently asked questions about the new Integrated Job Structure:

- Is its intent to lower salaries? *No*
- Will my salary change with implementation? *No*
- Must I meet all criteria for a level to be classified at that level? *Yes*
- Will occupation be the prime determinant of my salary? *No*
- How do I change level, occupation, or ladder? *Managers initiate changes*
- Are there any bidding restrictions for job postings? *No*

Medical Corner**Knowing what you need is sometimes not enough**

By Arlene Price

Occupational Health Programs Dept. 3335

We all develop habits we wish we could change. Sometimes we promise ourselves that we will make a change and actually make it but later slip back into old ways.

For example, you may promise yourself you will lose five pounds in a month, quit smoking, or start a new exercise program. When you don't accomplish your goal, you may feel you have

Presentation: How to keep the gains you make

Medical's Occupational Health Program Dept. 3335 is hosting a program, "When Knowing What's Good for You Isn't Enough," on Tuesday, Feb. 25, noon-1 p.m., in the Coronado Club Zia Room. Albuquerque psychologist Celia Michael will talk about how to maintain the gains you make in acquiring a new skill (weight loss, quitting smoking). For more information, contact Arlene Price (3335) at 845-8729.

failed and attribute your failure to a lack of willpower. Typically, you give up trying to accomplish your goal. How you judge yourself when you slip back into old patterns is crucial.

Backslide, slip, or all-out failure?

Two words used to describe slipping back into old patterns are "relapse" and "lapse." Relapse has been defined as "the act or instance of backsliding, worsening, or subsiding." A better description for relapse is that it is a process involving decisions you make and actions you take over a period of time.

The word lapse refers to a single occurrence such as a single mistake, an error, or slip. A good example is the figure skater who loses balance and falls on the ice. Whether the skater gets up and continues to perform depends largely on whether he or she views the fall as a slip or an all-out failure.

It's how you look at it

How you interpret an event or what you believe about yourself in a situation has been found to determine whether you will renew your efforts toward achieving your goal. If you have an "all or nothing" view of the world — that is, "I'm either a saint or a sinner; a success or a failure" —

Coronado Club

Feb. 13, 20, 27 — Thursday bingo night. Card sales and buffet start at 5 p.m., early birds' bingo at 6:45 p.m.

Feb. 14 — Valentine's Day dinner/dance. \$7.95 all-you-can-eat buffet; steak or shrimp, \$8.95, 6-9 p.m. Music by the Starlighter Boys, 7-11 p.m.

Feb. 16 — Sunday brunch buffet, 10 a.m.-1 p.m. \$7.95 all-you-can-eat buffet. Kids 3-12, \$1, under 3 free. Music by Swingshift, 1-4 p.m.

Feb. 21 — "Western Night" dinner/dance. \$7.95 all-you-can-eat buffet; steak or shrimp, \$8.95, 6-9 p.m. Music by Bobby Buttram, 7-11 p.m.

and the belief that one mistake is just one step away from failure, the tendency is to give up and say, "I can't do it."

By recognizing that mistakes are bound to happen while you are learning, you are able to continue toward your goal. In fact, you can learn from your mistakes and become even more effective the next time.

It doesn't matter whether it is a lapse or a relapse. Improving over time is a process as you learn new skills. The important thing to remember is that you are capable and that you can do it just as well as the next person.

Shoes for Kids says thank you to Sandia employees

On behalf of myself, Paul Robinson, the Albuquerque Public Schools that participated in the Shoes for Kids campaign, the parents whose children received new shoes, and the children themselves, thank you for your generous contributions to the Shoes for Kids campaign. The 1996 donations almost doubled from the funds donated during the 1995 campaign for a total of approximately \$11,300. We will serve 18 schools this year for a total of about 450 children in grades 1-5 and a grand total of more than 6,000 pairs of new shoes since the program's inception more than 40 years ago. Please know that no matter how small your donation, you were instrumental in making a difference in the lives of those less fortunate. Again, my sincere thanks and appreciation.

— Lisa Polito, Community Involvement and Issues Management Dept. 12650

Procurement's service center relocating to Bldg. 887

Beginning Feb. 24, if you're looking for Procurement's purchase requisitions service center, it's not where it used to be.

The PR service center is relocating from Bldg. 800 to a new location in Bldg. 887, Room 303. Also relocating to Bldg. 887 is APS/GSS (Accelerated Procurement System/Government Sources of Supply), formerly Department 10221, which is being merged with Department 10244. In recognition of its new functions, the new organization has been renamed "Commercial/Low-Value Procurement Dept. 10244."

The folks in these groups say to expect some possible delays in service in the period immediately preceding and following the move, although they'll make every effort to maintain their usual customer support while settling in.

Bldg. 887 is on the east side of Area 1, immediately outside the secured area, nearest the cross-section of H Avenue and 14th Street. The entrance is on the west side, at about the building's midpoint. To reach Procurement, take the hallway to the east and follow the posted signs.

Discovery Channel to feature nuclear weapons safety, Atomic Museum

Nuclear weapon safety will be one of four topics featured in a Discovery Channel program to air Wednesday, Feb. 26, at 7 p.m. MST (subject to change; check TV listings). The program, titled "Indestructible Machines," is one part of a four-part Discovery Channel series titled "Survival."

In October, a film crew from Pin Ball Productions spent a day at the National Atomic Museum filming the piece. They interviewed now-retired Sandia nuclear weapons program director Gene Ives about nuclear weapons safety and safing devices. Retired Sandian Randy Maydew discussed retrieving intact two of four B28 hydrogen bombs aboard an Air Force bomber following a midair collision in 1966 over Palomares, Spain.

The 14-minute program will feature three other "indestructible machines." The four-part "Survival" series will also feature such topics as the challenges of mountain climbing and the rigors of boot camp. The cable-based Discovery Channel primarily covers science and nature.

Sandia News Briefs**Labs demonstrates machine tool predictive maintenance system**

Sandia's National Machine Tool Partnership Program demonstrated to industry on Jan. 22 a real-time predictive maintenance system. The system is aimed at reducing unscheduled machine down time. A number of industrial partners in the program showed considerable interest in the shop floor demonstration. Sandia coupled its reliability modeling and predictive capabilities with its sensor technology to develop the WinR-PdMTM predictive maintenance system. The 15 attendees agreed to meet again Feb. 27 to explore a continuing business agreement with Sandia.

'On-Machine Acceptance' workshop draws industry interest

Sandia and AlliedSignal-Federal Manufacturing and Technologies (AS-FM&T) cohosted an On-Machine Acceptance (OMA) workshop for private industry at the Labs on Jan. 23. Sandia demonstrated an approach that integrates commercially available software and begins with a solid CAD model to generate both the on-machine probing and numerical-control tool paths. Sandia showed major potential cost and time savings for machined parts that require off-line inspection. AS-FM&T outlined the benefits of using an artifact to periodically test the performance of a machining center. The workshop was well attended and private industry showed considerable interest in the concepts presented. An OMA shop floor demonstration is tentatively planned for June at AS-FM&T. Participants agreed to meet in mid March to explore a continuing business relationship between Sandia and most of the attending companies.



SCENERY, SERENITY — The Sandia/DOE Singles Club offers lots of opportunities for comfortable companionship outside the workplace. These escapists, who cruised Lake Powell aboard a chartered houseboat, include (counter-clockwise from top): Bruce Hawkinson (12640), Darline Romero (12660), Bob White (6542), Susan Bridges, Linda Gonzales (7002), and Kay Nordeen (9601). Not shown are photographer Dick Beegle (1273) and his tutor, Sandy Culler (1323). For info, call club VP Vicky Gonzales (9601) at 284-2564.

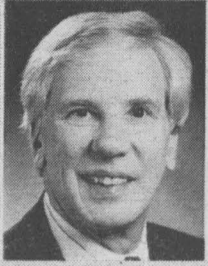
Send potential News Briefs to Lab News, Dept. 12640, MS 0165, fax 844-0645.

Labs Accomplishments 1996

Sandia National Laboratories • Albuquerque, New Mexico • Livermore, California

To all Sandians:

When asked about his satisfaction as a customer of Sandia, one industrial leader volunteered the observation that he had worked with most of the national laboratories and, in his opinion, "Sandia is unquestionably the best at application of science and technology."



When I first looked through the list of 1996 Labs Accomplishments,

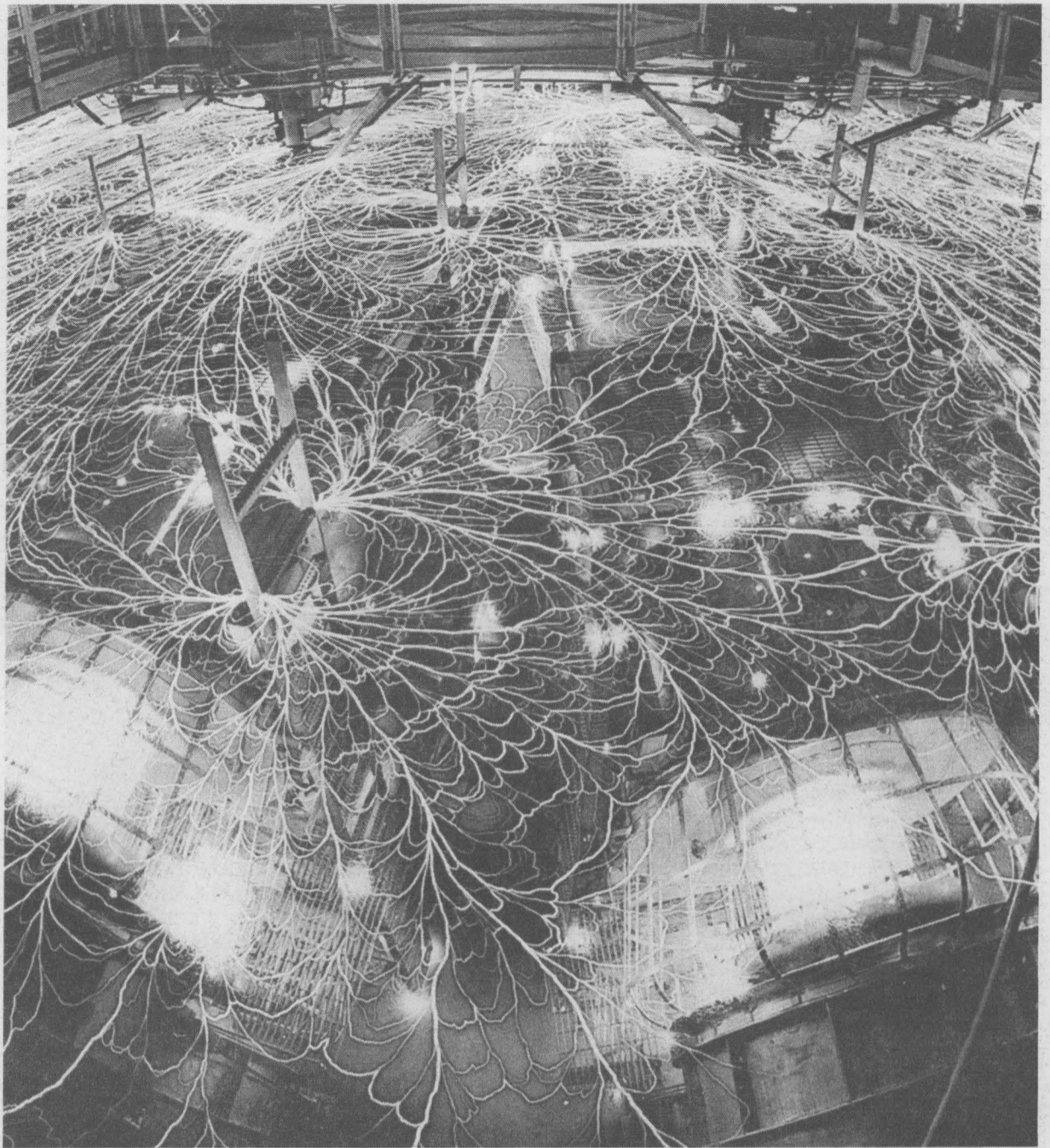
the accuracy of that customer's view of Sandia seemed apparent. We have produced an impressive list of achievements, the vast majority of which represents applications of science and technology to solve problems. Our applications serve the needs of internal customers as well as external customers (sponsors).

We produced a number of accomplishments that "made headlines" across the nation and in the international media. Foremost among these were the operation of the world's most powerful computer, the teraflops machine, the production of megajoules of X-rays using z-pinches, and the creation of silicon micromachines. With this came a large profusion of less well publicized, but still very important breakthroughs — from the development of new sensors to the creation of new software systems.

Present in this year's list are also a number of reengineering accomplishments to make our internal processes simpler and cheaper.

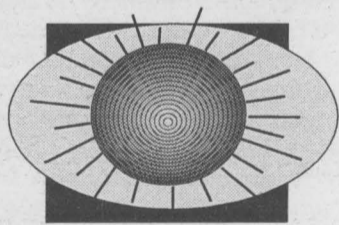
I urge you to read the entire list, with a view towards how these accomplishments — both technical and administrative — might help you do your job better. Please join me in congratulating all the men and women whose dedication and work produced these advances.

C. Paul Robinson
Labs Director and President



Z-PINCH BREAKTHROUGH — Sandia's pulsed power team, using the Labs' PBFA-Z (Particle Beam Fusion Accelerator z-pinch configuration), has produced record high bursts of energy, far exceeding the energy bursts such as the one pictured above on the PBFA-II, the predecessor to the z-pinch version. The accelerator shots aid computer simulations of nuclear explosion physics and move Sandia closer to reaching sustainable fusion in the laboratory. At the heart of PBFA-Z, the machine's tremendous bursts of electric energy create a powerful magnetic field that implodes a plasma, which when squeezed further releases heat and X-rays. (Photo by Randy Montoya)

Pulsed power



The PBFA-Z Project converted the existing PBFA-II accelerator into a z-pinch driver. PBFA-Z will provide an intense X-ray source for weapon physics and inertial containment fusion applications. The mechanical and electrical design, mechanical modifications, and initial pulsed power testing were successfully completed in FY96. We demonstrated the delivery of 50 terawatts of electrical energy to a z-pinch and validated the pulsed power components. Initial tests of the z-pinch X-ray source show that energy and power production follow computational predictions. Tests early in FY97 should reach the project milestones of 1.5 megajoules and 150 terawatts of X-rays. (9300, 9500)

The Sandia Radiation Sciences Program and the US Army Space and Strategic Defense Command began a joint program to use improvements in radiation-hardened integrated circuits to investigate no-upset system designs. Such a system could be simpler and have improved perfor-

mance over the traditional power-down strategy. Our work to develop a test technology to design and evaluate new, nontraditional, hardened electronics systems has resulted in the demonstration of no-upset performance at transient radiation levels as much as 1,000 times higher than recent electronics designs. (9300)

Advanced Hydrodynamic Radiography (AHR) is a critical capability needed to assure the reliability and safety of the enduring nuclear weapons stockpile primaries without underground testing. We have, in collaboration with Los Alamos National Laboratory and the Atomic Weapons Establishment (England), demonstrated the ability of Sandia's unique compact and inexpensive Inductive Voltage Adder (SABRE and HERMES-III) technology to drive a magnetically immersed electron beam diode and produce the very high brightness hard X-ray (Continued on next page)

 Sandia National Laboratories

Sandia LabNews

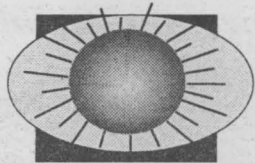
Special Section February 14, 1997

Toward the beginning of each calendar year the *Lab News* sums up Sandia National Laboratories' principal achievements during the previous fiscal year. This issue of *Labs Accomplishments* continues that tradition.

All Sandia divisions were invited to submit achievements, and the ones selected are summarized on the following pages. The work was accomplished during the fiscal year that ended Sept. 30, 1996. These brief summaries are not ranked in any way, but as in the past, we have grouped items that are obviously related. Key organizations contributing to each accomplishment are shown in parentheses at the end of each item.

Address requests for further information to Employee Communications and Media Relations Dept. 12640, MS 0165, Sandia National Laboratories, Albuquerque, NM 87185-5800.

Pulsed power



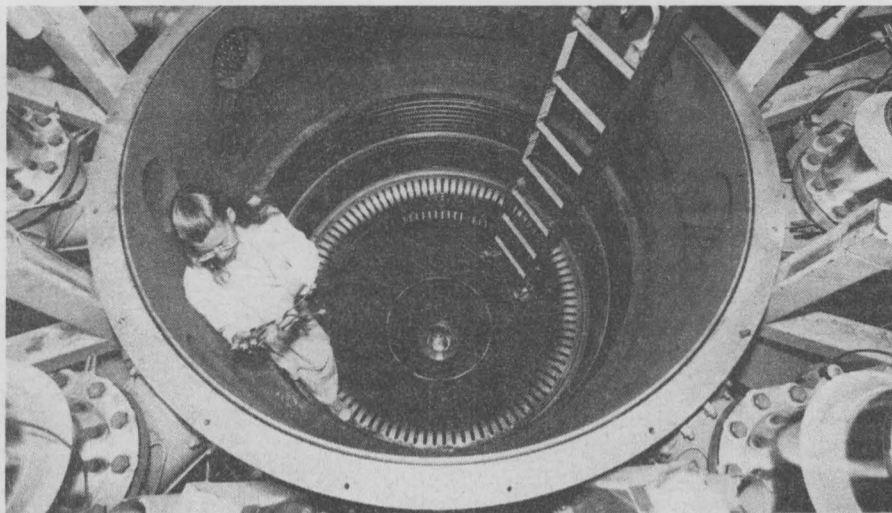
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radiation from the very small source diameter needed for AHR.

The X-ray power radiated from a z-pinch plasma was dramatically increased to 75 ± 10 trillion watts using the Saturn pulsed power accelerator. This peak radiation power level is nearly a factor of four greater than the peak electrical power delivered by the accelerator and was produced with an overall efficiency of approximately 13 percent. This breakthrough was made possible by new insights into the dynamics of z-pinch implosions and opens up new research opportunities in the areas of inertial confinement fusion and weapons physics. (9500, 9300)

The high energy, short-pulse X-ray emissions

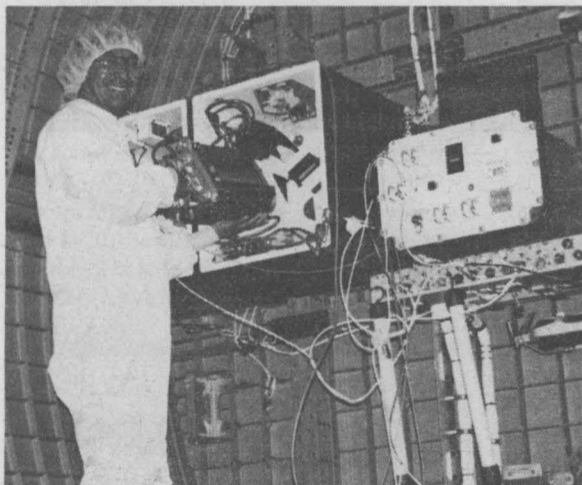
produced by the Saturn accelerator are used to characterize material by analyzing the shock wave induced by the X-ray energy. Saturn's intense radiation emission makes material characterization using electronic sensors difficult. Department 1554 personnel developed specialized Doppler interferometer-based sensors to perform detailed analysis on X-ray-driven "shocked" materials. This new development opens up a wide range of customer uses such as weapons effects simulation and equation of state modeling. (1500)



SATURN — Roberta Hanes of Saturn Operations Dept. 9342 removes volt monitors from the center section of the Saturn pulsed power accelerator following a test shot. During 1996, the X-ray power radiated from a z-pinch plasma was dramatically increased to 75 ± 10 trillion watts using the Saturn pulsed power accelerator. This peak radiation power level is nearly a factor of four greater than the peak electrical power delivered by the accelerator. (Photo by Randy Montoya)

Electronics, photonics, micromachines

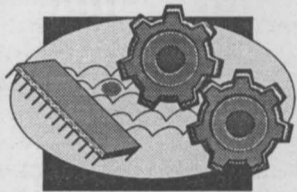
The Mechanics of Granular Materials experiment was performed on NASA's Atlantis space shuttle during the September 1996 MIR4 mission. The purpose of the experiment was to study the mechanical behavior of sand under low confining pressures (0.007 psig) in a microgravity environment. Sandia provided project leadership and designed, developed, fabricated, tested, and delivered the hardware essential to the success of the experiment. The experiment provided data useful in soil mechanics, geotechnical, earthquake, offshore, mining engineering, and many other applications. (5700)



SPACEWARD HO! — Al Baeza of Embedded Processor Subsystems Dept. 5731 loads a test cell for the Mechanics of Granular Materials experiment within the Space Hab aboard the shuttle Atlantis. The experiment flew successfully in September 1996.

We have significantly improved our agile manufacturing capability for small-lot production of compound semiconductor microelectronics and photonics with the implementation of in situ process control monitors on our epitaxial materials growth platforms. The process monitor, based on a simple optical reflectance technique supported by novel data analysis, allows rapid characterization of equipment performance. As a result we can now reliably and predictably grow complex device structures within 1 percent of design targets for multiple products/customers with turnaround times of days instead of months. (1100, 1300)

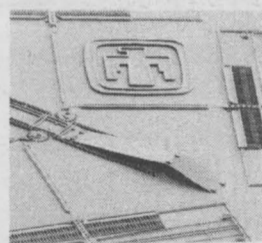
The first $0.5 \mu\text{m}$ CMOS application-specific integrated circuit (ASIC) has been successfully designed and fabricated in the Microelectronics Development Laboratory (MDL). This ASIC implements the Sandia-designed 8051-compatible microcontroller using the COMPASS tool set. Demonstration of this ASIC is a major milestone in the develop-



ment of the MDL as a fabrication facility for custom and radiation-hardened microelectronics. This capability is critical to Warhead Protection Program and space applications. Success on this milestone is a result of a team effort combining ASIC design and microelectronics technology development. (1200, 1300)

In the second year of a three-year internal R&D project, the "Tester On a Resident Chip" (TORCH) has yielded a spin-off to the Enhanced Radiometer (EnRad) Satellite Program. TORCH automates intra- and interchip analog measurements to assess integrated circuit reliability. Its designers created both a logarithmic analog-to-digital converter with a 106 dynamic range and a boundary scan interface for setup and control. Along with low noise amplifiers, these designs are being implemented for EnRad to allow rapid detection, digitization, and processing of transient optical data. (1200, 1300, 5700).

Micro-Electro-Mechanical Systems (MEMS) have the potential to miniaturize weapon system functions such as guidance, arming, and fuzing while decreasing costs and increasing robustness. By leveraging existing investments in semiconductor manufacturing technology, an integrated microelectronics/MEMS technology has been



MEMS MIRROR

developed for building systems-on-a-chip such as multi-axis inertial measurement units with application to weapon arming and fuzing functions. In addition, mechanical locking and energy coupling prototypes with applications in weapon safing and arming have been demonstrated. (1100, 1200, 1300, 2200, 2600, UC Berkeley)

We have discovered new polymer foams having dramatically high dielectric breakdown strength that should lead to better performing encapsulants. Most non-nuclear components in weapon systems, as well as components used in commercial technology (such as computer chips), must be encapsulated in polymer-based materials to prevent mechanical cracking and dielectric breakdown. Reducing a foam's cell size to 0.1-1

microns increases its breakdown strength by at least ten times. Compared to existing encapsulants having high breakdown strength, a foam encapsulant is less likely to crack a component. (1800, 1500)

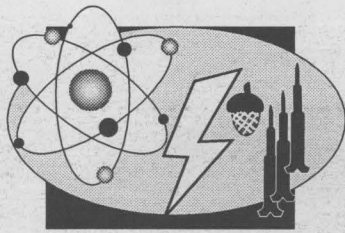
We have found that microelectronic gate oxides subjected to high-temperature hydrogen annealing develop unexpectedly large densities of mobile protons. The transport and trapping properties of these protons can potentially be exploited to form novel nonvolatile memory devices in bulk silicon or silicon-on-insulator technologies. Initial results indicate switching and retention times comparable to commercial memories and the enhanced radiation tolerance needed for defense and space applications. Texas Instruments is providing on-site personnel at Sandia to facilitate the development of this technology. (1800, 1300)

The 39 SEMATECH (Semiconductor Manufacturing Technology) projects active in 1996 provided technical advances for the integrated circuit industry National Technology Roadmap for Semiconductors (NTRS). Solutions were provided in the areas of lithography, packaging and assembly, contamination-free manufacturing research, equipment improvement, factory integration and productivity assessment, materials and bulk process, interconnect, test, and strategic technology projects. The program matrixed resources using the expertise of more than 300 Sandians in 109 departments during the last fiscal year. Since 1989, the 130 projects completed by Sandia/SEMATECH have supported the Labs' defense microelectronics mission. (1000, 2000, 3000, 5000, 6000, 7000, 8000, 9000, 12000, ORNL)



A TECHNICIAN working in the Microelectronics Development Lab loads silicon wafers into a furnace for heating integrated circuits. Sandia uses its world-class MDL facility for much of its cooperative research efforts with SEMATECH.

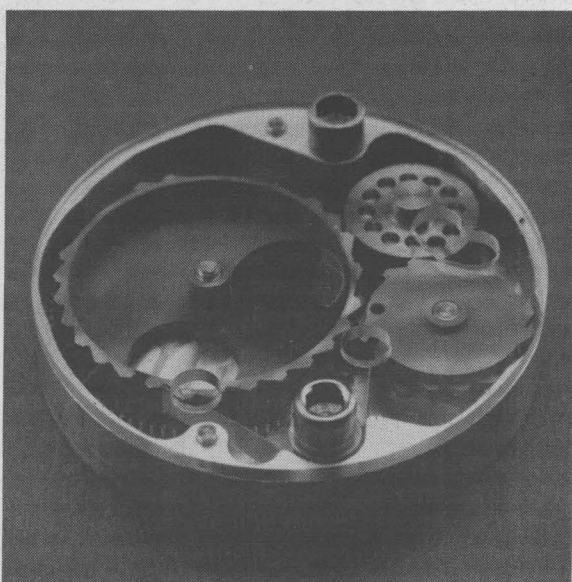
Nuclear weapons



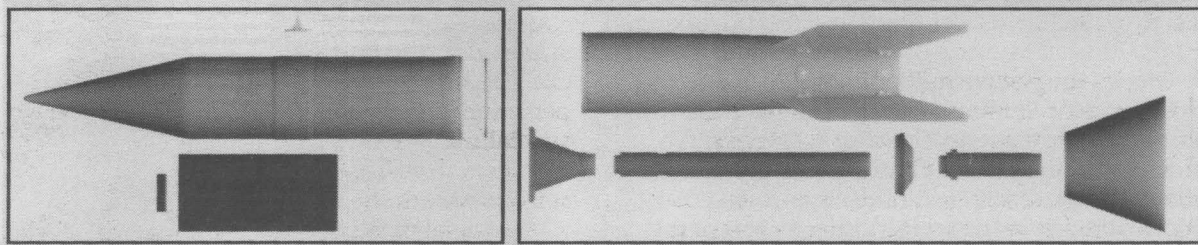
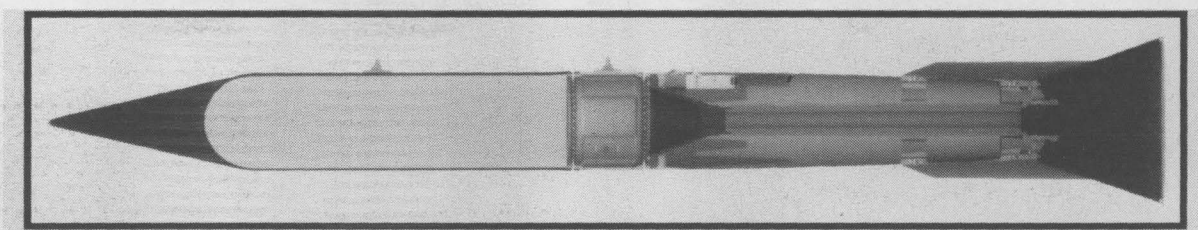
The B61-11 was authorized in August 1995 with a requested delivery date of Dec. 31, 1996. The B61-11 is a mechanical field modification to the B61-7. The B61-11 will be an earth-penetrating weapon that will replace the aging B53 bomb. The B61-11 may be delivered by a variety of aircraft including the B-2A, F16, and B-1B. The retrofit will consist of repackaging the Los Alamos physics package and Sandia's arming, fuzing, and firing (AF&F) electronics into a new one-piece steel earth-penetrating center-case designed by Sandia. We have conducted 13 full-scale drop tests this year, three in Alaska and 10 at the Tonopah Test Range, in support of the development program. Sandia has also designed and is fabricating for the Air Force ten trainers and nine sets of handling gear. The program is on schedule and B61-7 to B61-11 retrofit kits were to be delivered to the Air Force in December 1996. Retrofits were scheduled to begin in January 1997. (1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 12000, 14000)

PAMTRAK (Personnel and Material Tracking System) is a personnel tracking and material monitoring system developed to protect sensitive material. It integrates proximity badges, weight and motion sensors, and video cameras with a computer that reports attempts to steal or divert material. It can also communicate with a site's other security systems. It can reduce radiation exposure to workers and save money by reducing the frequency at which the material must be inventoried. PAMTRAK incorporates a variety of sensors to monitor material or personnel. (5800)

Significant advances in enhanced nuclear detonation safety (ENDS) were realized with the design and development of miniature Firing Set/Stronglink subsystems. Prototype devices, ranging from complete firing systems to application-specific detonator safing devices, are being modeled and evaluated. Miniature machining, photolithographic (LIGA) semiconductor processes, and silicon micromachining are employed to fabricate these devices. These subsystems offer many opportunities to systems designers for miniaturization and for enhancing the safety, security, and reliability of retrofitted weapons. (2600)



SAFING — Miniature machining, photolithographic (LIGA) semiconductor processes, and silicon micromachining are employed to fabricate devices such as this Detonator Safing Device.



Case Subassembly
All Components will be preassembled into the case

Property	B61-7	B61-11
Weight - Lbs.	763±15	1212±15
Nose & Al. Cir. Case / EP Case	535	827
Pre-flight	50	50
Tail	178	335
Length - In.	141.6	145
CG - In. from nose	60.25±0.5	60.50±0.5
MI - Lb. In 2		
Spin	15000±200	23800±500
Pitch & Yaw	819000±25000	1795000±50000

Tail Subassembly
All Components will be preassembled into the tail



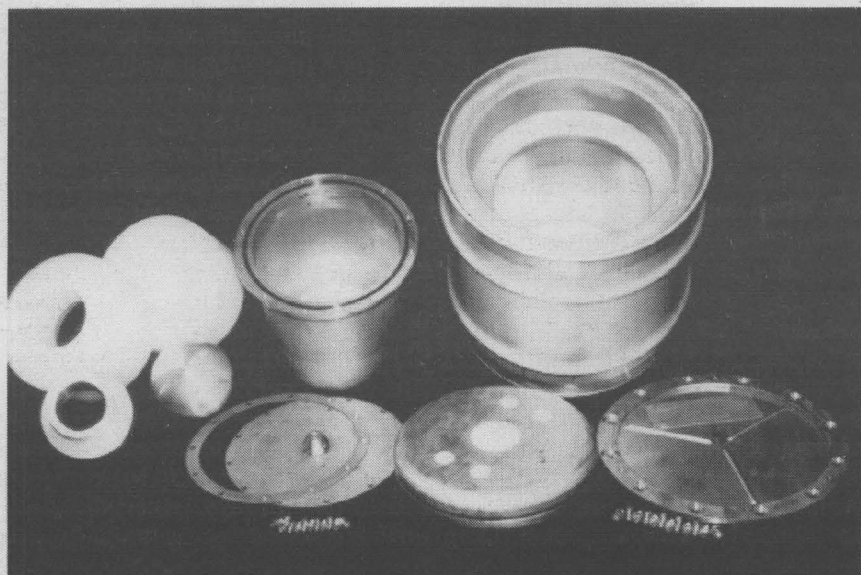
Sandia National Laboratory

B61-11 Program

Los Alamos National Laboratory

The minimum terms of the June 1992 US/Russian Agreement, "Safe and Secure Transportation and Storage of Nuclear Weapon Materials Through the Provision of Fissile Material Container Containers," were met by shipping 10,000 AT-400R containers to Russia. Sandia had responsibility for interface, design, development, and testing for the Defense Special Weapons

acquired shock histories in critical locations throughout the warhead electrical system and the neutron generators, providing data for code validation. Through the use of Sandia's advanced visualization capabilities, our system designers, analysts, and shock physics instrumentation personnel developed an in-depth understanding of the complex 3-D explosion through which the neutron generators must survive. (1100, 2200, 8700, 9200)



SAFE SHIPPING — Above is a model of the AT-400R shipping container designed by Sandia for use in handling Russian fissile materials.

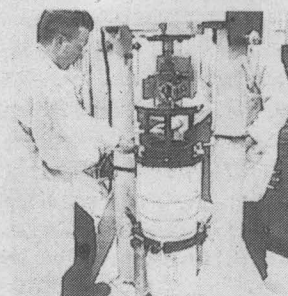
Agency (DSWA). DSWA produces the containers and ships them to Russia. Approximately 14,000 containers are planned to be shipped next year, and this number may be significantly increased. (2100)

The Assembly Traceability Database (ATD) project migration was completed in August 1996. The ATD captures actions such as initial builds, reworks, retirements, and retrofits on major assemblies and components for weapon systems maintained within the nuclear weapons complex. In all, more than 28 million records were moved from an IBM mainframe to a Sun client-server environment with an expected operational savings of approximately \$250,000 dollars per year — a 10:1 cost reduction. Business practice improvements were also incorporated. (4600, 9700)

We completed three-dimensional simulations and experimental correlation of the neutron generator standoff phenomenon for the Warhead Protection Program Pit Reuse Warhead. Simulations were completed with Sandia's PCTH hydrodynamic code on the Labs' Intel Paragon supercomputer. Experimental data were acquired from two primary hydrodynamic implosion tests conducted jointly with Lawrence Livermore National Laboratory. Our instrumentation

The third major milestone of the B83 Quality Improvement Program (QIP) was achieved when a B83-1 equipped with Alteration (ALT) 750 was produced at Pantex and accepted by DOE in March 1996. Alt 750 incorporates the MC4033 dual-channel common radar into the B83-1 bomb. This B83-1/Alt 750 was the first B83 bomb produced that includes all of the QIP component improvements. Sandia engineers worked closely with production engineers at Pantex and AlliedSignal/Federal Manufacturing & Technology to ensure the successful transition of Alt 750 from development to production. (2200, 2300)

Dismantlement of the W55 was restarted and nearly completed. The process had been stopped due to safety concerns associated with cutting the aft case. During the nearly three-year hiatus most of the dismantlement process, including the case-cutting operation, was redesigned. The process changes resulted in a safer and more efficient process, which allowed dismantlement to proceed faster than anticipated. Since restarting the dismantlement line early in FY96, all but a few of the remaining W55s have been dismantled. (2200)



W55 DISMANTLEMENT

A modern data communication system prototype was developed jointly with New Mexico State University. This system quadruples the frequency bandwidth efficiency of present systems and has the ability to transmit data at rates in excess of 100 million bits per second. Advances in digital signal-processing technologies and modern digital encoding techniques for error correction made the implementation feasible. The system has the potential for another four-fold improvement in both the bandwidth efficiency (Continued on next page)

Nuclear weapons

(Continued from preceding page)

and data communication rate. The project was funded through the Labs-Directed Research and Development office. (2600)

Advanced Vehicle Development Dept. 5516 delivered four **Portable Integrated Video Systems (PIVS)** to nuclear accident response teams working for the Russian Ministry of Defense. Originally developed for System Studies Dept. 12331 and the DOE Accident Response Group (ARG) to enhance post-accident recovery of nuclear weapons, PIVS provides command and control personnel located remotely with secure, real-time visual and verbal information from the accident site. As part of the deliverable sponsored by the Defense Special Weapons Agency (DSWA), Sandia staff trained Russian military personnel in the deployment of PIVS during regional emergencies. (5500)

Military Liaison (ML) provides stockpile support through classroom and field training in weapons handling and maintenance, explosive ordnance disposal, bomber/fighter crew procedures, and weapon refresher training to DoD and DOE personnel. **In FY96, ML trained more than 1,500 students** — a 50 percent increase over recent years — due to the growing demand for nuclear weapons skills, knowledge, and qualification. At the three-day Symposium on Nuclear Weapons, more than 200 Sandians reviewed the nuclear weapons program, received feedback from our customers, and discussed future challenges. (14700)



CLASS ACT — Shown here are some of the 1,500 students who participated in training coordinated by Military Liaison during 1996.

The Safeguards Transporter (SGT) team has completed a prototype vehicle on time and within budget. The prototype was used to validate the system against its requirements and has



LAYING IT DOWN — A B1-B bomber on a test run deploying the B61-11 at the Tonopah Test Range. Sandia conducted 13 full-scale drop tests this year, three in Alaska and 10 at the Tonopah facility.

provided an opportunity for the customer, DOE's Transportation Safeguards Division, to assess the product prior to production. A successful Nuclear Explosive Safety Study was conducted in June 1996. The Final Design Review was completed in July 1996. Production has been authorized. (5500)

A **Modular Telemetry methodology to design Joint Test Assembly (JTA) telemetry systems** has been developed. This methodology employs an array of virtual circuit modules that have been designed, simulated, tested, and routed for later use in telemetry systems, such as for the W76, W78, W80, and W87. The designers can call up the required pre-designed modules and place them on any shaped circuit board for subsequent fabrication. The Mod TM effort is ongoing for future additions and refinements. The goal is to reduce the design time while increasing design robustness and flexibility. (8400, 2200)

Electrical models of all detonators in the enduring stockpile have been developed. These

models are based on a flexible template characterizing both pre- and post-burst performance. They have been **validated with high fidelity data taken by the Cable Discharge System tester** in the Explosive Components Facility. These models provide a critical stockpile stewardship foundation for analyzing firing system design margins, trouble-shooting future anomalies, and performing trade-off studies in the context of reduced testing. (8100, 1200, 1500, LLNL, LANL)

The Model Validation Project (MVP) further established a new role for Sandia's extensive laboratory test capabilities by **developing new experimental capabilities necessary for validation** of a new generation of modeling tools being developed for model-based certification of weapons. Experimental validation procedures were demonstrated for weapon modeling of fire environments, foam encapsulants in fires, highly nonlinear deformation during crush-up events, and transmission of shock and vibration through mechanical interfaces. (9700, 9100, 9200, 2100)

As members of the Software Quality Assurance Subcommittee (SEAS) of the Nuclear Weapons Complex (NWC) Quality Managers, we produced SQAS96-002, "Guideline for NWC Processes for Handling Software Product." This guidance supports the requirements of EP401099, Product Realization Process, and supplements existing Engineering Procedures. Four important software product-handling processes are defined:

- **identification** — for architecture and configuration management;
- **qualification** — for functional and performance quality engineering;
- **acceptance** — for authorization of use; and
- **delivery** — for exchange of product between supplier and customer. (12300, 2600, AS/KCD, PX, DOE-AL/WQD)

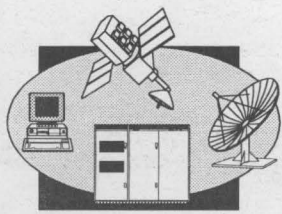
Stockpile Surveillance Program Dept. 12303 **evaluated 113 nuclear weapons** in FY96. All weapons were denuclearized and instrumented in test configurations at Pantex. Seventy-four were tested, in various environmental conditions, at Sandia's Weapons Evaluation Test Laboratory at Pantex. Thirty-nine warheads were flight-tested with operational delivery systems. Twenty significant-finding investigations were opened to determine the reliability and safety impacts and appropriate corrective actions for anomalies detected during these tests. All results were reported to DOE's Weapons Quality Division, which requires that this activity be accomplished yearly to continuously demonstrate the reliability, safety, security, and readiness of the nation's nuclear stockpile. (12300)

Computation/information

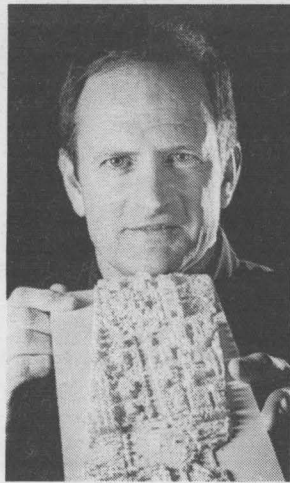


TRILLIONAIRE — James Tomkins (9224), teraflops project manager for procurement, checks out one of the teraflops cabinets shipped to Sandia from Intel Corp.'s Beaverton, Oregon, facility. In 1996, a DOE/Sandia/Intel team using an Intel massively parallel computer broke the trillion operations per second milestone on test runs using benchmark software. (See accomplishment listing on next page.)

Computation/information



A team of Sandia communications personnel created a part of the information superhighway by converting its core data networking technology to a full mesh of routers utilizing asynchronous transfer mode (ATM) switching at individual link rates of 155Mbps. This conversion increased both the bandwidth and availability of the core network for distributed customers. At the same time, Sandia, Intel, and GigaNet collaborated to create the first ATM interface for the Intel Paragon operating at 622Mbps. This ATM interface received an R&D 100 Award for its innovative approach to high-performance computer communications. (4600, 4900, 8900)



SAR-BASED MODEL

Organization 5912, with the cooperation of Organization 1484, has developed techniques to produce extremely accurate topographic models using SAR (synthetic aperture radar) data. This modeling capability can be used for both urban and non-urban terrain, and the results can be applied to a number of applications such as precision-guided munitions. The site characterizations that are possible with such techniques have generated considerable interest in the military arena, particularly for special forces. (5900)

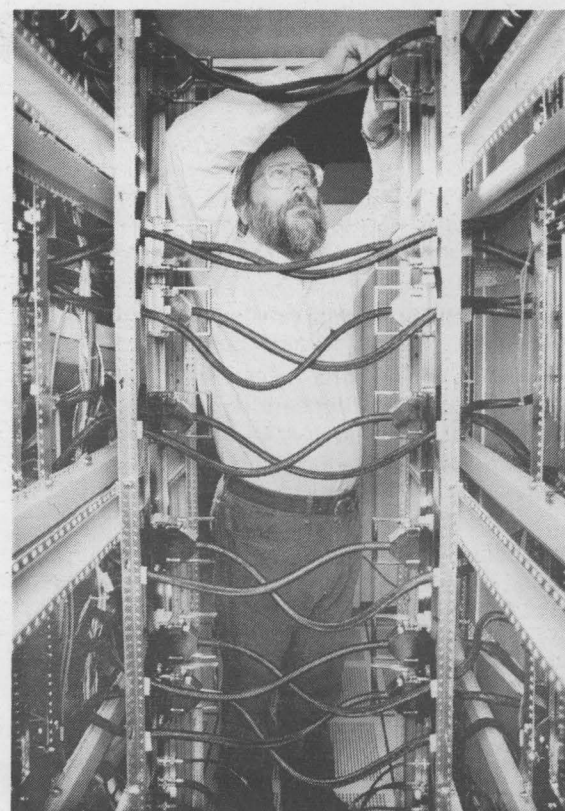
The Human Resource, Procurement, and

Financial systems were redesigned to support staff augmentation contracts. A new invoice-costing system allows contractors to enter their time charges on a real-time basis rather than submitting costs after the fact, sometimes many months later. This change is expected to save \$25 million annually due to decreased supplier overhead rates. Labor charges are costed weekly rather than forecasted, which increases project management flexibility and accuracy. Shortened invoice cycles also improve supplier cash flow. (3000, 4000, 10000)

New standard, high-technology PCs began appearing on desktops the last quarter of FY96 as part of Sandia's PC leasing program. Implementation happened after the Sandia Quality Leadership Council approval in early June as a result of cooperation among Purchasing, Property Management, and IIS personnel. Five local vendors provided 779 standard leased computers in the last quarter (56 percent of the total PCs acquired). Five-hundred eighty-two standard desktop PCs were leased in September (71 percent of the month's total). (4400, 10200, 7600)

Novel porphyrin-based materials are being developed for use in ultra-fast, ultra-high-density optical memory devices. Computer-aided design methods tailored the memory properties of the materials, which were subsequently synthesized at the University of California. Measured improvements in the optical and magnetic properties validated the computational predictions. Memory retention times of candidate materials were improved 500-fold, and 30-ps memory-state switching times (approximately 100 times faster than conventional devices) were achieved. Identified pathways for further improvements are being pursued. (6200, 9200, 8300)

Sandia's supercomputer R&D project with Intel smashed the trillion-operations-per-second (teraflops) hurdle in December, setting a new world record. The massively parallel LINPACK benchmark ran at 1.07 teraflops on 3/4 of the ASCI teraflops supercomputer in Intel's integration facility in Oregon. This



TERAFLOPS supercomputer systems administration manager Michael Hannah (4918) checks cables on the teraflops system's disconnect cabinets, which permit the systems to be used for both classified and unclassified computer work.

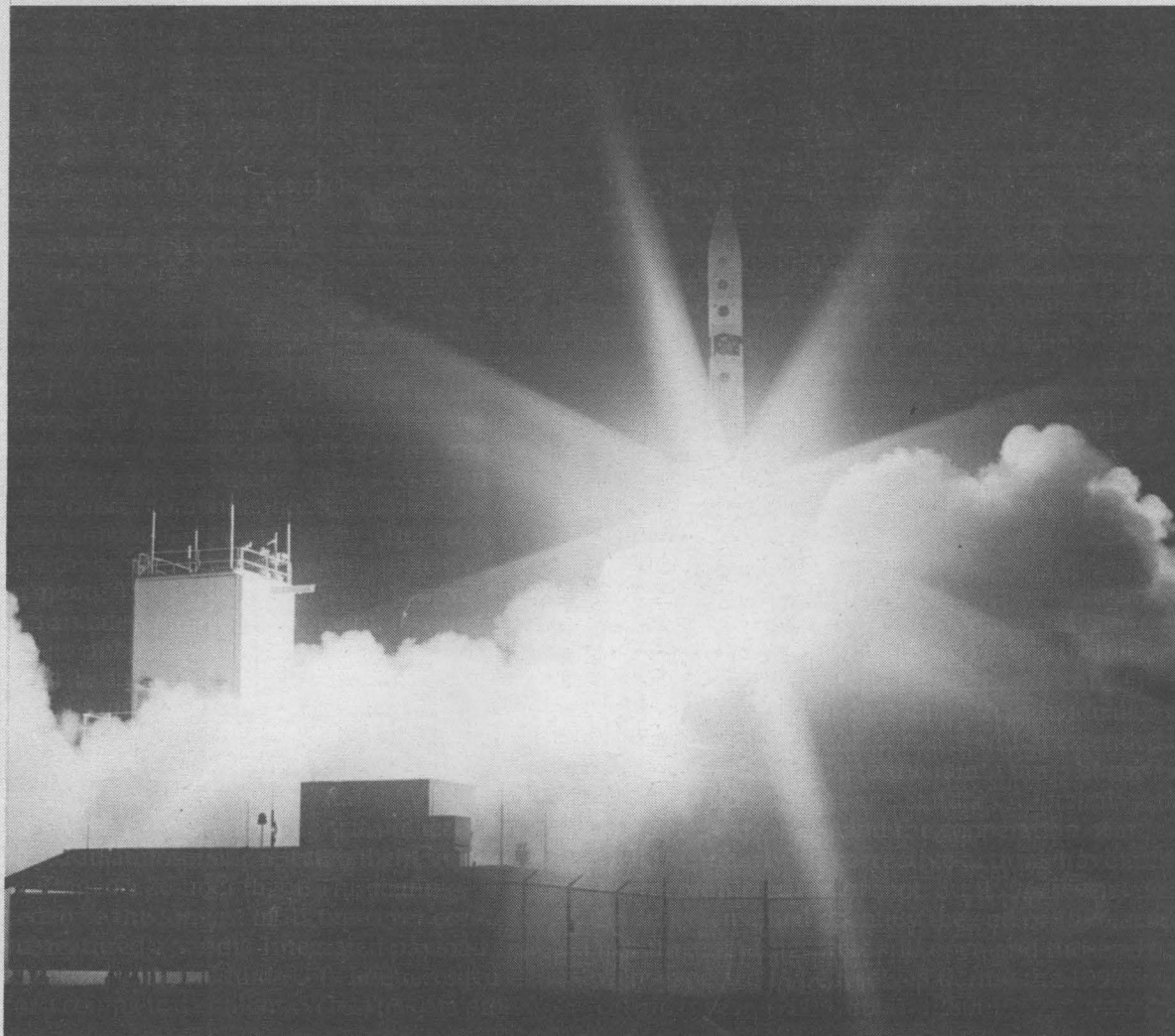
record leapfrogs the 368 gigaflops record set by a Hitachi system in Japan earlier in 1996, which itself beat Sandia/Intel's 283 gigaflops mark set in 1995. The record also marks the first milestone toward DOE's goal of attaining 100 teraflops by 2005. (9200)

We developed a scalable decomposition algorithm for interfacial contact problems on massively parallel computers. This algorithmic development overcomes what was long considered a key impediment to performing simulations involving large deformations on parallel computers. This technology will perform previously unachievable models and simulations on the teraflops computer for complex problems
(Continued on next page)

Nonnuclear weapons

The Low-Cost GPS (global positioning system) Guidance for Tactical Munitions project is funded through the Joint DoD/DOE Memorandum of Understanding for Nonnuclear Munitions Technology Development. Fast GPS acquisition, direct to the encrypted Y-code, under dynamic conditions was accomplished in a rocket sled test. The demonstrated acquisition time of six seconds represented an improvement of a factor of five in the state of the art. A low-cost GPS antenna was designed to demonstrate reduced vulnerability to jamming for systems on spinning missiles or projectiles. (2500, 2300)

On Aug. 31, 1996, Sandia launched a STARS II booster system from the Kauai Test Facility to support the Midcourse Space Experiment (MSX) satellite. Twenty-five target objects were deployed off the Operational Deployment Experimental Simulator (ODES) post-boost vehicle designed by Sandia. The primary purpose of this mission was to provide target objects to evaluate the MSX sensors. Sandia designed and fabricated 10 of the target objects and coordinated all payload and missile integration efforts. The mission was highly successful, and significant target signature data was collected for the National Missile Defense programs. The Ballistic Missile Defense Organization sponsored this program, which was coordinated through the US Army Space and Strategic Defense Command. (1400, 2400, 2500, 2600, 2300, 8100, 9100, 9700)



Computation/information

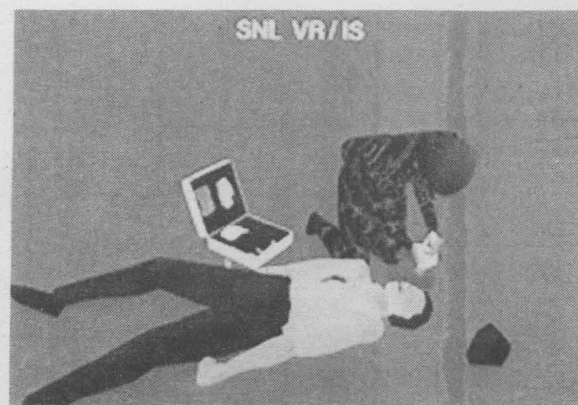
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involving large, nonlinear deformations such as the B61-11 penetrator; the B61-3, 4, 10 laydown bomb; and the Warhead Protection Program. The development has broad implications for the field of computational mechanics. (9100)

Crash simulations are essential to stockpile stewardship and other Sandia missions, as well as the automobile industry. A key step in these calculations is the detection of contact, such as when a car bumper buckles into the radiator. Unfortunately, previous attempts to perform these simulations on massively parallel computers have been bedeviled by the lack of a good parallel algorithm for contact detection. In a major breakthrough, researchers in 9100 and 9200 have combined to solve this long-standing problem,

allowing for simulations of unprecedented complexity and fidelity. (9100, 9200)

The Virtual Reality (VR) Team from Department 5913 successfully demonstrated the integration of its high-fidelity medical trainer, VR-MediSim, with DoD's large-scale DIS simulation architecture. VR-MediSim is a virtual reality system intended to train emergency medical personnel. **It enables medics to be immersed in a virtual world** where they are confronted with real-life casualty situations. The integration of VR-MediSim with DIS provides, for the first time, an environment that also supports the training of combat medics in the midst of the action under battlefield conditions, just as our pilots and armed forces are trained using simulation today. The infrastructure developed here is also being used to explore the use of VR-based



VIRTUALLY REAL — A screen shot of the Sandia-developed VR-MediSim virtual reality medical training simulation. The simulation creates a "high-consequence" environment, adding verisimilitude to training scenarios.

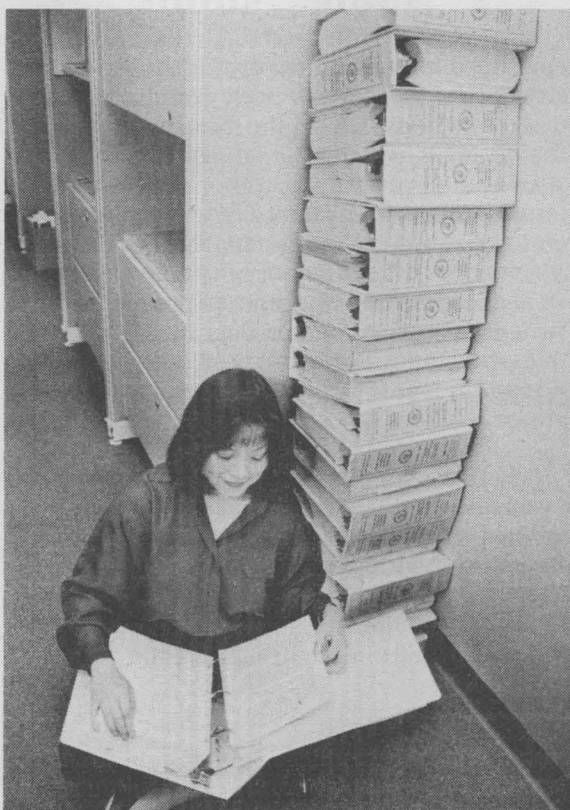
training systems for use in combating terrorism and in enabling Sandia's stewardship of the nation's nuclear stockpile. (5900)

Energy & environment



A major milestone in the DOE Mo-99 radioisotope production program was accomplished this year with the **production of the first samples of the key medical isotope molybdenum-99, or moly-99**. DOE issued a Record of Decision in September, selecting the Sandia Annular Core Research Reactor (ACRR) and Hot Cell Facility (HCF) as the site for US production of this key medical isotope. Mo-99 is currently used in 10 million nuclear medical procedures per year in the US, and the US is currently supplied exclusively by a single reactor in Canada. (9300)

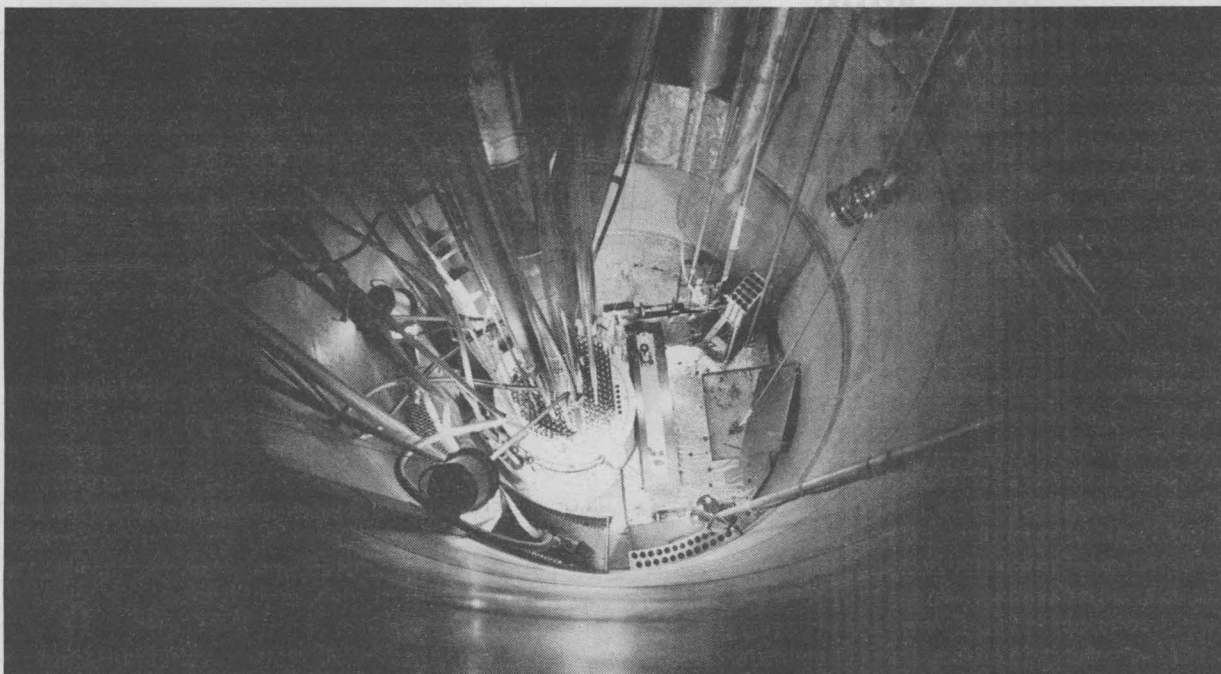
The Compliance Certification Application for the Waste Isolation Pilot Project was completed and **submitted to the Environmental Protection Agency for review 62 days early**. The completion and successful review of the CCA represents the next significant step leading toward the opening of WIPP and receipt of transuranic waste in November 1997. Sandia has led the development and implementation of field tracer tests to identify and quantify mechanisms controlling transport in a fractured rock unit at the Waste Isolation Pilot Plant (WIPP) site. Transport models from these tests were then incorporated into the



WIPP Deputy Project Manager Margaret Chu (6801) scans the first volume of 20,000 pages of documentation presented in support of DOE's Compliance Certification Application to EPA.

recently completed compliance calculations for WIPP. (6100, 6800)

A Document of Understanding (DOU) was completed in April 1996 that summarizes all



MOLY-99 — Inside Sandia's Annular Core Research Reactor, which has been selected by DOE to produce medical isotopes for the US medical industry.

Sandia provided system engineering and implementation support to the DoD family of Commander-in-Chief, Mobile Alternate Headquarters (CMAHs) throughout FY96. This included delivery of a new 40-foot Multi-Media Communications Shelter (MMCS) to the NORAD/USSPACECOM Mobile Consolidated Command Center and upgraded MILSTAR capability for the USTRATCOM CMAH. In addition, Sandia is providing support for a "future look" analysis of new commercial off-the-shelf networking technology to be inserted in these platforms to maintain modern equipment capability. (6500, 1500, 2300, 9700, 10200)

agreements relating to acceleration of the Sandia and Los Alamos Environmental Restoration (ER) projects and serves to ensure consistency across both ER projects and regulatory agencies in how corrective actions are accomplished. The document was the outcome of a joint effort by DOE, Los Alamos, Sandia, the New Mexico Environment Department, and the US Environmental Protection Agency. The DOU Team won a 1996 gold DOE/AL Team Quality Award. The following Sandia groups and outside organizations made significant contributions to this accomplishment.

Sandia/New Mexico Groups:

Environmental Restoration Project Dept. 6681 (formerly 7581)
Environment Safety & Health Center 7500
Environmental Technologies & Applications Center 6600

Outside Organizations:

Los Alamos National Laboratory Environmental Restoration Project
DOE, Albuquerque Operations Office
DOE, Kirtland Area Office, Albuquerque, NM
DOE, Los Alamos Area Office, Los Alamos, NM
New Mexico Environment Dept., Santa Fe, NM
US Environmental Protection Agency, Region 6, Dallas, TX

Sandia researchers are performing large-scale tests and related analyses to understand the failure of **commercial nuclear reactor pressure vessels under the thermal and pressure loads** associated with a severe reactor accident like that which occurred at Three Mile Island Unit 2. The existing best-estimate structural models incorrectly predict failure of the TMI-2 vessel. (The TMI-2 vessel did not fail.) In FY96, a detailed scaling analysis and three tests, in a matrix of eight, were completed in this project, which has strong international interest. (6400)

Surface Area Modulation (SAM) telemetry technology offers a **possible breakthrough in petroleum field operations** and has attracted considerable interest from the petroleum industry. The novel, wireless communication link is two to three orders of magnitude faster than current wireless technologies and uses oilfield tubulars, such as

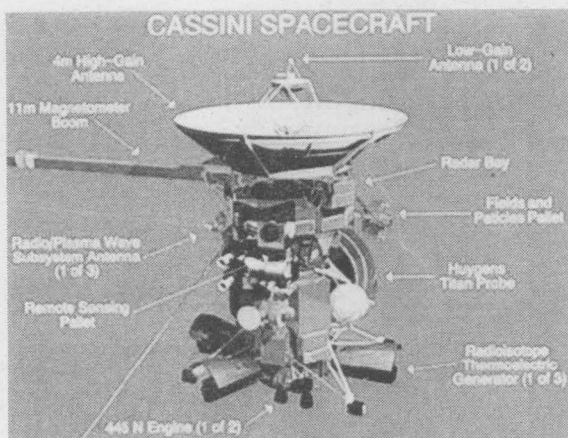
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Energy & environment

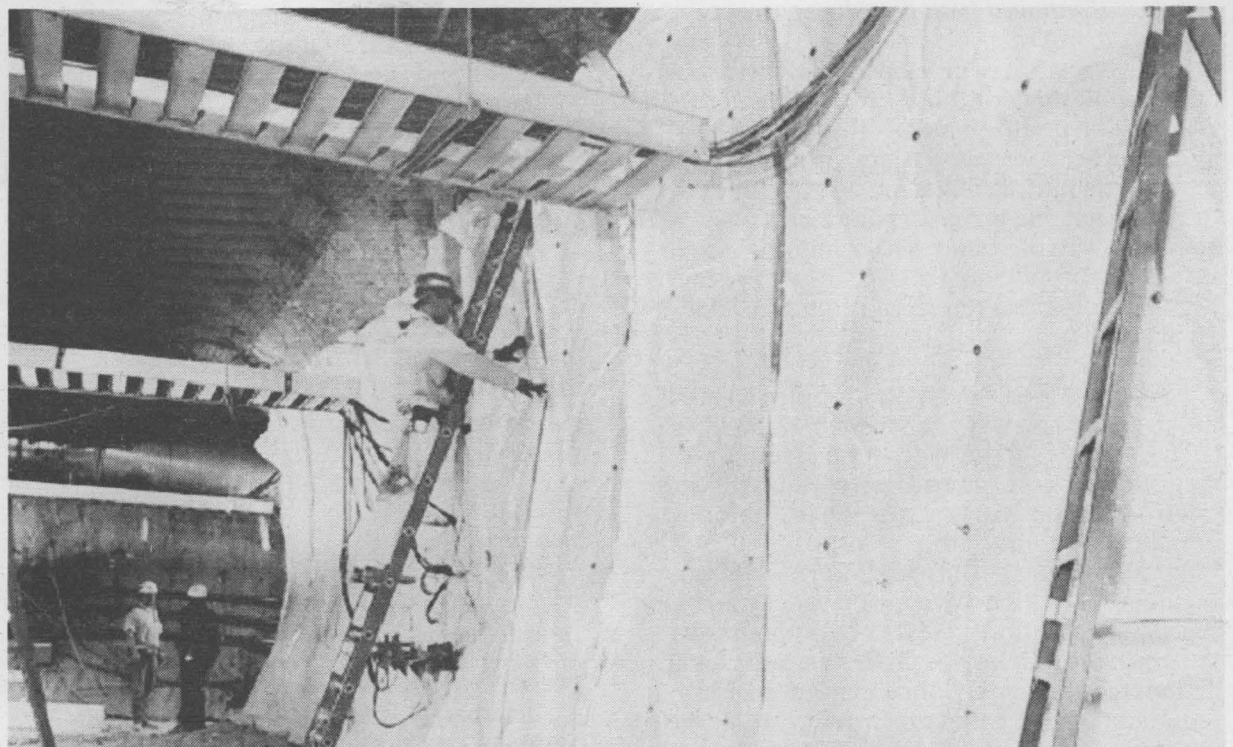
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production tubing and drill pipe, to transmit real-time downhole data to the surface for production monitoring and formation evaluation. A commercialization effort has attracted nine interested companies, and a CRADA to jointly develop commercial products has been initiated. (6100, 2600)

Sandia has provided innovative technical support for the safety analysis of the NASA Cassini mission to Saturn. Electricity for the mission will be provided by radioisotope thermoelectric generators (RTG) fueled by Pu-238. In response to requirements imposed by the Interagency Nuclear Safety Review Panel (INSRP), a mathematical technique has been developed to analyze and separate the uncertainty and variability associated with the probability of radionuclide release in postulated launch and re-entry accidents. A detailed time- and temperature-dependent thermochemical kinetics model of the macroscopic fireball behavior and the plutonium transformation within it has also been developed. Funding is provided by DOE. (6400, 9100, 5500, 9400)



One of the major remaining issues in the characterization of Yucca Mountain as a potential high-level nuclear waste repository site is an



YUCCA MOUNTAIN — Dave Bronowski (on ladder) puts final touches on the insulation covering the Single Heater Test Block. More than 600 data channels of instrumentation were inserted in 34 boreholes to measure temperature, moisture, and displacement in the rock mass.

understanding of the thermally driven processes resulting from emplacement of nuclear waste. Sandia's Nuclear Waste Management Center (6800) was a major participant in the design and fielding of the first thermal test in the underground Exploratory Studies Facility at Yucca Mountain. The test is designed to address questions regarding the effect of heat on the mechanical and hydrological behavior of the rock. (6800)

Under the auspices of the Gore-Chernomyrdin Commission, Sandia led the development of the Russian/American Fuel Cell Consortium (RAFCO). On Sept. 17, 1996, former Secretary of Energy Hazel O'Leary and Russian Minister of Atomic

Energy Viktor Mikhailov met in Vienna, Austria, and signed an international agreement to implement RAFCO. RAFCO will help focus expertise in both countries toward accelerating development of fuel cells for emerging markets while promoting nonproliferation goals. RAFCO projects will team Russian nuclear institutes, DOE national laboratories, and US industry. (6200, 5300, 1800, 4200, 4500)

To save money while retaining Sandia's operational flexibility, ES&H adopted an innovative approach to the Clean Air Act's Title V Operating Permit Program. Sandia worked with City of Albuquerque. (Continued on next page)

Production

On Jan. 13, 1996, the construction of Bldg. 870 was completed 30 days ahead of schedule and within budget. By Sept. 30, 1996, 84 percent of the building occupancy had been completed, including completion of the Readiness Assessment for those portions of the building. The first neutron tubes containing tritium were fabricated in Bldg. 870 in April 1996 and delivered to the customer in May 1996. Significant teaming between the user group, facilities organizations, and contractors was required. (14000, 7900)

In support of the nonnuclear reconfiguration project for DOE/AL/WQD, Division 14000 was able to meet the programmatic milestones needed to demonstrate neutron generator production operations at Sandia. All W76 neutron generator shipments to the Navy during FY96 were completed as scheduled. Also, processing of neutron generators returned from the field, to be reaccepted by DOE for reuse by the Navy, began this year. All phases of the W76 underwent major requalification procedures but maintained production capabilities. (14400, 1400, 9700, 1500)

The neutron tube manufacturing facility achieved its first major milestone in FY96 by producing 65 tubes for the neutron generator development team. To achieve this milestone, the manufacturing infrastructure and approximately 40 new processes were developed. Equipment was installed, fabrication capability was established for more than 250 operations, and personnel were trained while the final facility modifications were being implemented. Prototype development activities will continue as the arduous task of developing a War Reserve manufacturing environment continues over the next year. (1400, 1800, 7600, 7700, 10250, 14300, 14400, 14700)

We completed reconfiguration of the Switch Tube manufacturing capability operated by EG&G in Salem, Mass., for the Sandia MDE (manufacturing development engineering) production program. The production capability was reconfigured to support development and WR production of the Poco Sprytron product family after a strategic decision was made to abandon the capability to produce old product designs. The reconfiguration project began in March 1996 and was complete in September 1996 at a cost of \$1.5 million and is expected to result in annual cost savings of \$3 million. (1500)

Sandia met its commitment to Pantex to deliver a fully functional Pantex Process Model (PPM) to Pantex by the end of FY96. The PPM has the unique ability to analyze two very different types of production operations, dis-

mantlement and evaluation, which use common resources (facilities and technicians), and to provide optimal combined output. It is now being used by Pantex to support planning and scheduling of all Pantex production operations, where it has exceeded the expectations of both Pantex and DOE. (6600)

Environmental testing responsibility for the MC3359 Timer has been transferred from Pinellas to Sandia's Manufacturing and Rapid Prototyping Dept. 9742, which developed testing processes, procedures, and documentation used for radiographic inspection, mechanical shock, vibration, and climatic preconditioning. It developed and implemented recommendations to change testing sequence and modify fixturing, to reduce cycle time and cost by over 50 percent. The department has undergone an independent performance-based audit by Quality Assurance Dept. 12336 and was found to conform to Quality Criteria - 1 (QC-1). (1500, 12300, 14300)

Three projects represent substantial progress in the development of production infrastructure. A Product Data Management (PDM) system with Web interface was designed and implemented to provide necessary configuration control and online access to manufacturing and product information. A client/server-based graphical user interface, Production and Certification System (PACS), was developed and implemented to capture and report product certification and traceability required for product submittal to DOE. A Manufacturing Resource Planning (MRP) system was implemented, which serves as a major tool for cross-functional business integration in satisfying production needs. (14300, 1500, 4000, 10200, 10400, 7000, 14400)

The Manufacturing Development Engineering (MDE) program manages ongoing component needs for components that are designed at Sandia and built by different suppliers across the US. An MDE Supplier Conference was held in Albuquerque for MDE partners from Sandia, DOE, and the supplier community. This first-time event was an opportunity for the MDE community (suppliers, Sandia designers and procurement, and DOE interface) to begin to shape the way we communicate and conduct business for the future. Attendees participated in group activities that focused on improving Sandia/supplier/DOE interface and continuing win-win relationships. Working groups will be formed to work on processes and action items that resulted at the conference. A formalized action plan will be sent to all conference attendees. (14000, 1000, 1200, 1300, 1400, 1500, 9700, 4200, 10250)

Energy & environment

(Continued from preceding page)

querque regulators to develop a facility-wide operating permit that does not increase line record-keeping or reporting burdens. This approach is also expected to **reduce current annual permit fees by one-half**. Sandia is the first DOE site to have its operating permit application deemed complete. This has resulted in nomination to participate in the Environmental Protection Agency's Regional Pollution Prevention Permitting Pilot Project. (7500)

An Integrated Safety, Environmental, and Emergency Management System (ISEEMS) has been developed to provide a **consistent and standard process for addressing hazards and environmental issues** across the laboratories. The Preliminary Hazard Screening and the Environmental Checklist/Action Description Memorandum modules are in place. By answering simple questions, ISEEMS helps managers determine the facility or project hazard classification, required safety documentation, and required training based on current regulations and orders. ISEEMS can save weeks of preparation time to complete basic hazards documents. In pilot testing the system was enthusiastically acclaimed by line organizations. (7500, 2000)



SOY SAUCE — Ernie Salas (7614), left, pumps soybean oil into a Sandia grader hydraulic system. Looking on is Lou Homar, director of the University of Northern Iowa Ag-Based Industrial Lubricants research project.

In an effort to increase the use of biodegradable lubricants throughout US industry, **Sandia Fleet Services will test soybean hydraulic fluid** in select pieces of its equipment. Sandia will install the US grown, pollution-reducing oil in forklifts, sweepers, and garbage trucks in a joint field test with the University of Northern Iowa. Soybean lubricant is expected to perform similarly to other hydraulic oils, but the vegetable-based fluid should be easier to dispose of once proper government regulations are in place. (7600)

By utilizing an optically accessible diesel engine and advanced laser-sheet imaging diagnostics, **we have uncovered the details of the early stages of diesel combustion** from fuel-air mixture preparation through auto ignition and the onset of soot formation. The results of this investigation provide a critical component of the improved understanding of diesel combustion required by industry to meet new emissions and efficiency requirements. This work, part of a cooperative research and development agreement, received the Society of Automotive Engineers Horning Memorial Award, one of the Society's highest recognitions. (8300)

The Atmospheric Radiation Measurement-Unmanned Aerospace Vehicle (ARM-UAV) program, a Sandia-led multilaboratory team, recently completed an atmospheric research flight series culminating in a 26-hour flight. This flight, believed to be **the longest of its type ever conducted, featured a Sandia-integrated payload** carried aboard a high-altitude UAV and recorded data for a complete day-night cycle. The data pro-

vided by the ARM-UAV program, supported by DOE and the DoD Strategic Environmental Research and Development Program, will help improve large-scale meteorological and climate computer models. (8100, 8400, 2200, 2700, 5700, 8500, 9200, 8700)



RE-OPENING FOR A NEW MISSION — California Laboratory VP Tom Hunter snips the ribbon, marking the successful transition from the Tritium Research Laboratory to the Chemical and Radiation Detection Laboratory.

A major accomplishment for the California site in 1996 was the **successful cleanup of the former Tritium Research Laboratory** and its subsequent conversion to the new Chemical and Radiation Detection Laboratory (CRDL). The result of this effort is a modern, high-quality laboratory facility, the CRDL laboratory. This new facility has been dedicated to the support of Sandia/California's rapidly growing Advanced Detection Technologies Program. CRDL is the centerpiece for our growing business in forefront sensor development. (2200, 8300, 8400, 8500)

A three-year, \$7 million project for **developing an understanding of the origin and fate of air toxic species** in industrial processes was successfully completed. The project involved seven cooperative research and development agreement partners (five refinery and two natural gas industry), two universities, and two national laboratories. The data will be used by the Petroleum Environmental Research Forum partners as industry input to discussions with the US Environmental Protection Agency. These discussions will significantly influence the next generation of regulations governing the performance of industrial process heaters. (8300, 8100)

An interdisciplinary team of Sandians provided **essential and timely support of the Pantex Site-Wide Environmental Impact Statement**. Nuclear weapon safety personnel teamed with experts in reactor-accident analysis and explosives modelers to assess the potential for offsite releases associated with postulated accidents during weapon disassembly operations. In addition, nuclear weapon safety personnel provided essential data to estimate the possibility of aircraft crashes into the site. With these issues resolved, DOE was able to file its site-wide environmental impact statement. (12300, 6400, 6600, 9100, 6600)

A total of 639 findings were assessed during the Tiger Team assessments conducted at Sandia/California and Sandia/New Mexico in 1990 and 1991 respectively. These were later consolidated into 561 findings, each with individual corrective action plans, some of which extended beyond 2001. Thanks to the joint efforts of corrective action owners and Sandia's Appraisal Management Office, and the cooperation of DOE/AL, **nearly all corrective actions have been completed**. As of Sept. 30, 1996, seven findings remained open. By the end of 1996, just three findings were still open and those were expected to be resolved during the 1997 calendar year. (7000, 8000, 12800)

Advanced manufacturing

The "Intelligent Systems for Induction Hardening Processes" team won the Lockheed Martin NOVA Award for "developing an intelligent controller for induction hardening, the first technology developed under the Partnership for a New Generation of Vehicles (PNGV) and deployed in production." Induction hardening is a broadly used manufacturing process to strengthen regions of ferrous parts (Defense Programs applications include advanced penetrators). Under a cooperative research and development agreement with GM, the system is presently controlling the case depth of Saturn intermediate shafts with precision five times better than industry standards. This project has been used as a lab-industry success story by President Clinton. (9100)

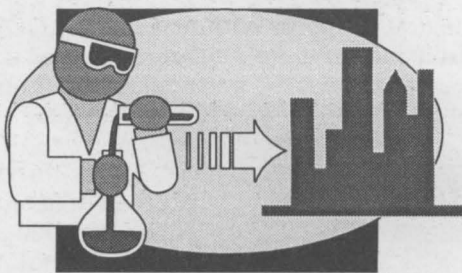
For the first time at Sandia, a complex part was taken from concept to inspected, flight-quality part with a completely paperless process. The Bomb Impact Optimization System (BIOS) Flight Test Program polycarbonate nose tip is a very complex shape requiring five-axis machining capability. **No drawings were created. Solid models of the part were developed using Pro/Engineer**, which were compatible with the software packages used for finite element analysis, numerically controlled machining, and inspection. Because of the process, changes to the part were allowed, even as it was being machined, without significant downtime. (2100, 9700, 1400)



A **prototype Electronic Traveler** has been developed to support the fabrication and quality certification requirements for transfer system hardware for use in a shelf storage program. The prototype incorporates a Web-based interface that enables design engineers, process engineers, machinists, and inspectors direct access to the design database and to easily enter the required product information. Data integrity is established by password-controlled access to specific users, and by storing the data in the corporate Product Data Manager system. (8200, 8400, 8900)

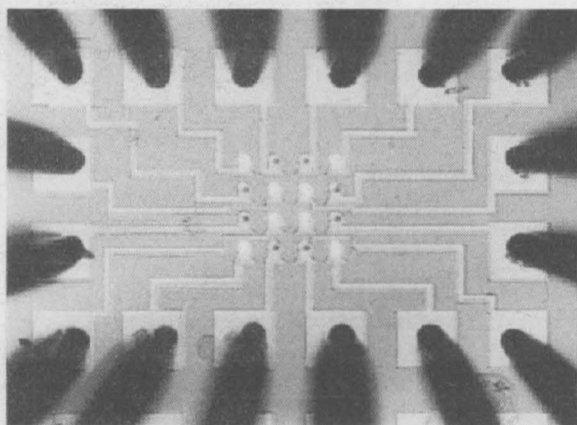
The Archimedes computer-aided assembly planning system was **successfully applied to a 303-part subassembly of the center-case of a B61**, and the output was used to drive a WaveFront animation of the resulting assembly sequence. The benchmark was performed to determine the value of Archimedes for generating field upgrade training videos. It was judged a success on several fronts; the resulting technical advances will reduce the effort required to produce such videos in the future by days and perhaps weeks. (2100, 9600)

Technology transfer



This was a watershed year for Sandia's licensing and industry funds-in activities: Commercial licenses increased 300 percent to 101 agreements, covering more than 79 pieces of intellectual property. Licensing income approached \$.75 million, patent applications were steady at 100, and invention disclosures declined slightly to 214. Cash funds coming into Sandia from industry partners totaled \$26.7 million: \$12.4 million from cooperative research and development agreements; \$13.4 million from Work for Others/Non-federal Entity agreements; \$719,000 from User Facility agreements; and \$172,000 from technical assistance agreements. (4200)

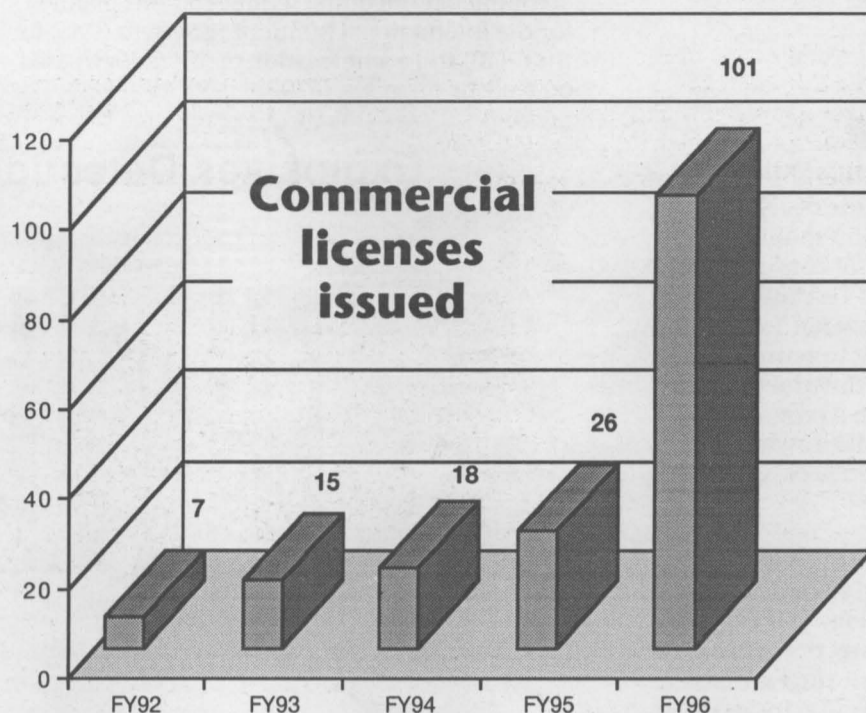
The Optoelectronics Industry Development Association (OIDA) recently highlighted vertical-cavity surface-emitting lasers (VCSELs) as a key technology for the 21st century. Sandia has made great strides in this area with the successful transfer of visible VCSEL technology to Xerox Corporation and Honeywell Corporation under a Defense Advanced Research Projects Agency-sponsored program. Sandia's contributions include advancing the performance of visible VCSELs to meet laser printing and plastic fiber data link system specifications as well as transfer of VCSEL growth, heterostructure design, and fabrication capability to industrial partners. (1100, 1300)



VCSEL — Sandia-developed vertical-cavity surface emitting lasers were called a key technology of the 21st century for the optoelectronics industry.

The Advanced Technologies for International and Intermodal Ports of Entry (ATIPE) project is developing a secure information system, based on the Internet and using intelligent agents and cryptography, that will be used to collaboratively process commercial shipments through US-Mexico ports of entry by various stakeholders (federal inspection agencies, customs brokers, transportation providers, and manufacturing shippers). The project, which is sponsored by the New Mexico Highway Department and the Federal Highway Administration, includes developing border crossing process maps and prototyping an intermodal container monitoring and tracking system. (5500, 5800, 6200, 6500, 6600)

In partnership with the Aluminum Company of America (Alcoa), we have developed a computer code for modeling the kinetics of precipitate evolution in supersaturated alloy solid solutions. The rate-theory code provides an important tool that can be used in the optimization of alloy processing strategies. Features of the code that make it particularly valuable in this regard are the abilities to model effects on

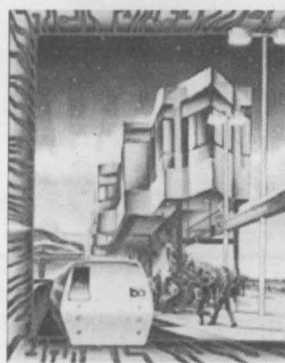


WATERSHED YEAR — As indicated by the chart, Sandia's licenses efforts had a watershed year in 1996, issuing 101 license agreements for Sandia intellectual properties, including patents and copyrights.

precipitate microstructure resulting from finite cooling rates, varied thermal histories, and changes in fundamental thermochemical parameters. (8700)

Our steel sensors team completed development — including design, construction, and field testing — of: 1) lance-based, fiber-optic-coupled sensors for real-time monitoring of the melt temperature in basic oxygen furnaces (BOFs); 2) optical range-finding sensors for monitoring oxygen-lance position and refractory wear in BOFs; and 3) tunable-diode-laser-based sensors to monitor CO and CO₂ in real time in BOF off gas. Data are being linked to key steelmaking process variables, and commercialization of sensors was initiated with the American Iron and Steel Institute. (8300, 8400, 8700)

An existing CRADA with the San Francisco Bay Area Rapid Transit (BART) district was amended to include two tasks associated with Bart's Advanced Automatic Train Control system. This system, currently being developed and tested by BART and Hughes Aircraft with Defense Advanced Research Projects Agency funding, will improve system performance by allowing closer spacing of trains. The two new Sandia tasks are: 1) safety analysis and review at both the software and system levels; and 2) development of enhanced control algorithms to manage energy efficiently, subject to safety and schedule constraints. (1200, 2200, 8100, 12300)



BART

Patents & Licensing Dept. 11500 had the following significant accomplishments during FY96:

1. Processed more than 200 new invention disclosures.
2. Filed 102 utility patent applications with the US Patent and Trademark Office.
3. Prosecuted to issuance 46 new US Patents.
4. Drafted and executed more than 100 commercial license agreements in support of Orgs. 4200 and 8800, resulting in more than \$700,000 in royalty income. (11500)

A project team from the Robotics Center delivered an automated sewing system, based on a unique, Sandia-developed sensor, to Textile/Clothing Technology Corporation (TC2) of Cary, N.C. This delivery completes a two-year CRADA to transfer advanced Sandia capacitive sensor technology to the US apparel industry. The goal of the CRADA, funded through the AMTEX Partnership, was to apply advanced sensors to automate sewing processes, increasing seam quality and reducing operator fatigue. TC2 representatives believe this technology will help make the US garment

industry more competitive. (9600)



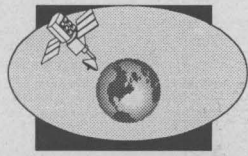
SEW, SEW — Jon Bryan (9611) instructs a Textile/Clothing Technology Corporation sewing operator in the use of an automated sewing system at its manufacturing facility in Raleigh, N.C. The machine uses unique sensors developed at Sandia under the AMTEX CRADA.

Sandia managed a project teaming Sandia, Lockheed Martin, and Delta Airlines that developed and validated an advanced technique for repairing commercial aircraft.

The technique centers around the use of bonded composite doublers in lieu of conventional, riveted metallic patches. Advantages include: elimination of rivets and associated stress risers, high strength-to-weight ratio, corrosion resistance, formability to complex shapes, and time savings in installation. Sandia also produced inspection procedures that have been included in industry-approved directives allowing the use of bonded composite doublers. (9700)



Arms control/verification/security systems



The Tactical Unattended Ground Sensors Program (TUGS) is responsible for the development of a sensor system to aid in counterproliferation efforts. During the year a proof-of-concept experiment, performed at the Nevada Test Site under a Defense Special Weapons Agency funded contract, **demonstrated the ability to remotely detect, identify, and locate industrial machinery.** This is a multi-organizational program including participation by Sandia, Lawrence Livermore National Laboratory, and ENSCO Inc. (2500, 5700, 6100)

The proliferation of nuclear weapons is a major threat to the security and stability of the world. Sandia provided technology and expertise in **upgrading the physical protection of nuclear material in selected facilities in the Former Soviet Union.** Quality results were achieved by applying a systematic approach to physical protection systems analysis, design, implementation, and testing. Despite cultural differences, Sandians have benefited from the exchange of physical protection philosophies and international project management experience. Work continues on upgrades and infrastructure development within 44 facilities. (5300)

The Cooperative Monitoring Center (CMC) conducted training workshops on cooperative monitoring technology for **representatives from China, South Asia, the Middle East, South Korea, Northeast Asia, Russia, and Latin America,** including a verification training course for the Israeli delegation to the Middle East Arms Control and Regional Security Process, sponsored by the Arms Control and Disarmament Agency (ACDA). These workshops are given to political and technical experts. They promote the development of technical expertise needed to negotiate, evaluate, and implement regional arms control and confidence-building agreements. (5300)



CMC WORKSHOP

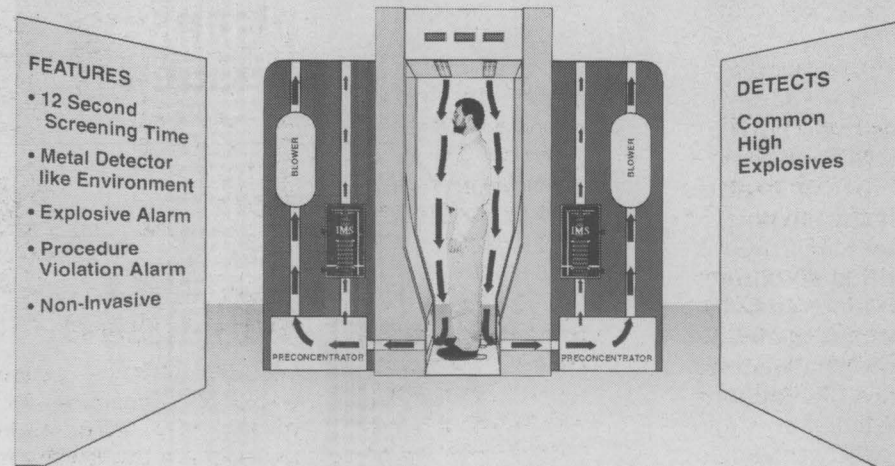
The Air Force Space Test Program Office and DOE are in the process of drafting a Memorandum of Agreement for the **launch of the Multispectral Thermal Imager (MTI) satellite.** MTI is sponsored by DOE's Office of Nonproliferation and National Security and implemented by a Sandia-led team that includes Los Alamos National Laboratory, Savannah River Technology Center, Air Force Phillips Laboratory, and several industry contractors and universities. The project objective is to demonstrate and evaluate space-based multispectral and thermal imaging technology for a number of military and civilian applications. The agreement is the result of the project receiving formal rankings of 1st out of 17 and 2nd of 31 by the Air Force and DoD Space Experiment Review Boards (SERBs), respectively, based on military relevance and quality of experiment. (5700, 1300, 1500, 1800, 2300, 2400, 2500, 2600, 5400, 9100, 9200, 9700)

We modified a large network simulation code called NetSim to provide estimates of global seismic network performance. This code was applied in a variety of backstopping exercises for the US delegation's negotiations on the Comprehensive Test Ban Treaty (CTBT). The **modified code also provides insight into improvements that can be realized** (if necessary) by calibrations of monitoring stations and regions. The current modified version of NetSim includes, among several enhancements, additional station capacity to

accommodate all of the seismic stations planned for the International Monitoring System (IMS) for the CTBT and event location methodology based on realistic premises. (5700)

biological weapons. Within Sandia, CALIOPE is a broadly matrixed project that has tapped unique resources and has the potential for additional spin-offs. (1100, 5700, 8100, 8300, 9500)

Explosives Detection Portal



Sandia delivered ground terminals for the US Nuclear Detonation Detection System to US Space Command and to US Strategic Command. These **Ground NDS Terminals receive sensor data from up to six global positioning system satellites** at a time, process the data, and generate real-time nuclear event reports in support of nuclear attack assessment and nuclear force management missions. Ada software developed at Sandia and ruggedized antenna, receiver, and computer equipment were integrated into the user's mobile command and control system. (5700, 6500, 2600, 5900)

Sandia is developing capabilities in UV laser remote sensing in the CALIOPE project (Chemical Analysis by Laser Interrogation Of Proliferation Effluents), as part of a five-laboratory program sponsored by DOE. FY96 activities culminated in highly successful field test operations at the

Nevada Test Site, where we **demonstrated multi-spectral fluorescence and absorption-based lidar (light detection and ranging) capabilities** at significant standoff distances and against blind targets controlled by DOE. Although the prime application of this work is the detection of nuclear weapon proliferation activity, applications are under way to apply this technology to the growing threat of terrorist and military use of

exceed the FAA's explosives detection goals. The preconcentrator technology can also be adapted to support other detection needs such as chemical and biological agents, narcotics, and land mines. (5800)

We **designed and deployed a portable site gate monitoring system** for characterizing and screening vehicular traffic. This system was demonstrated to foreign journalists from the Middle East and South Asia. This same system was redeployed at another Sandia facility and demonstrated remotely from Canada during the North Pacific Arms Control Workshop that included representatives from the US, Canada, China, Japan, Russia, and South Korea. Additionally, we have contributed to the development of a portable display of monitoring technologies for use at international forums. (5800)

To support monitoring of the upcoming Comprehensive Test Ban Treaty (CTBT), Sandia has developed a new **algorithm for automatically finding natural and man-made events.** The Waveform Correlation Event Detection System locates events in global sensor data by matching the current pattern of sensor output at every point on the globe with historic patterns. This technique overcomes an exponential increase in compute-time experienced by previous algorithms when trying to deal with the large quantity of data and low signal-to-noise ratios needed to monitor the CTBT. (6500, 6100, 5700)

Laboratories support

The **workforce restructuring announced on Dec. 5, 1995, was completed in FY96 and no involuntary layoffs were necessary.** To achieve this result, a realignment of the staff was conducted, in which 327 positions were declared impacted. The successful resolution of these impacts was achieved both through the offering of a Voluntary Separation Incentive Program and through internal placement of people. The "bottom line" for the successful realignment was the integrated approach involving ongoing partnering between HR, the line and executive management, labor unions, DOE, and community leaders. (3500)

The **Enterprise Business Applications Program** was launched by Sandia upper management in March 1996 to deploy commercial business application software. Aligning Sandia's basic business processes with those enabled by commercial software is viewed by executive management as a pragmatic way to streamline Sandia's business processes and reduce costs. The most significant step in FY96 was the evaluation and purchase of commercially available PeopleSoft applications for

the Payroll, Benefits, and Human Resource areas. A cross-divisional team has been organized to deploy these applications in FY97. (3000, 4020, 4800, 10500)

In early 1996, the **Sandia Quality Leadership Council** reaffirmed the importance of Sandia's national security mission and **defined eight new strategic objectives for Sandia.** For each strategic objective there are "owners" responsible for achieving more specific annual milestones. The concept of "line of sight" linkages to the strategic objectives and the annual milestones has been deployed using Performance Management Forms for all employees. Progress toward the annual milestones will be reviewed and published quarterly. The 1996 planning effort involved direct input from many Sandia employees. (4500, 12100, and many others)

In response to Secretary O'Leary's challenge to Sandia to develop a model diversity program, Sandia was recognized this year for its accomplishment. (Continued on next page)

Laboratories support

(Continued from preceding page)

ments. In October 1996, the Lockheed Martin HR organization presented an award to Sandia for the diversity leadership program. Sandia also received an award from the American Society for Training and Development. Sandia continues to share information as a benchmark company for other companies and DOE facilities. Within the community, the Executive Forums on Diversity are now being supported by other businesses. (3600)

A new point-of-service medical benefit program was implemented in January 1996 after extensive customer input through focus groups and benchmarking. The objectives of the program were to provide Sandians with more choice, to encourage managed care, and to control costs. Agreements were reached with executive management, DOE, and three bargaining units. A multimedia communication plan was developed. Volunteer ambassadors helped assist with the communication. (3300)

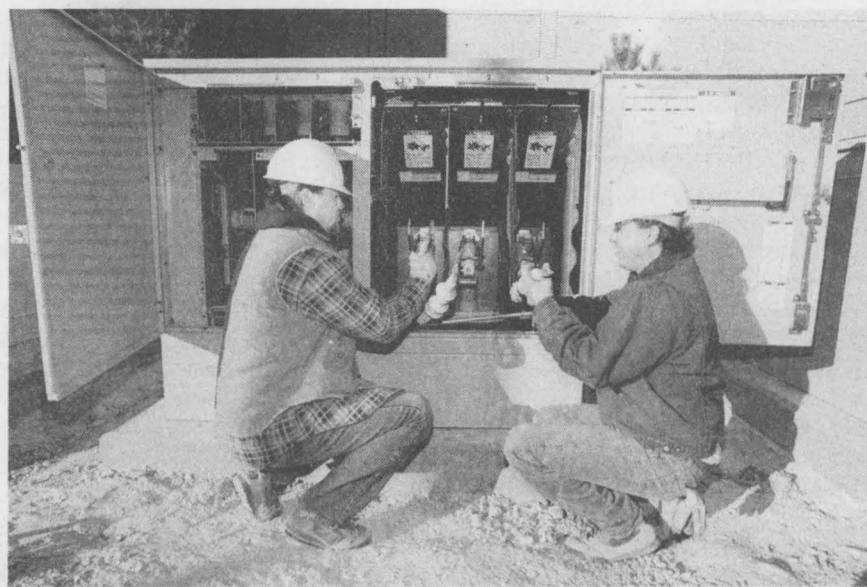
Collective bargaining agreements with the Office and Professional Employees International Union (OPEIU) and Metal Trades Council (MTC) Unions expired Sept. 30, 1996, and the agreement with the Security Police Association (SPA) expired Nov. 30, 1996. All agreements were negotiated without any interruption of the Labs' work. Early settlement with the OPEIU resulted in a 35-month contract; a 34-month contract was signed with the MTC (both to expire July 31, 1999). A five-year agreement was reached with the SPA. (3500)

Several Integrated Information Services departments teamed together in 1996 to improve Sandia's remote services infrastructure. These services allow Sandians to access services like the Internal Web from home or when traveling and also provide network connectivity for on-site staff in areas where there are no network drops. Analog dial-in capacity to the Internal Restricted Network (IRN) was increased from 4 to 75 ports, and ISDN capacity was increased from 30 to 48 ports. In addition, a toll-free number was added for IRN access to make the service more convenient for

travelers. Similar enhancements were provided for the External Open Network (EON) as well: analog dial-in ports were increased from seven to 48 and ISDN capacity was increased from 12 to 24 ports. New modems on the EON also increased the speed of dial-in communications from 14.4 Kbs to 28.8 Kbs. (4400, 4900)

The Power System Modernization (PSM) construction project has made substantial progress toward replacing an antiquated high-voltage distribution system. The PSM replaces an out-of-date, undersized distribution and subtransmission system with a modern power system that allows for future growth. The PSM will improve reliability, flexibility, efficiency, ease of maintenance, and safety. This will result in fewer scheduled outages, decreased restoration times after unplanned outages, and reduced maintenance cost. The success of this project, currently within schedule and budget, relies on continuous teamwork among several centers. (7800, 7900, 10200)

The Corporate Quality Department provided full deployment of the 1996 Sandia President's Quality Award Program. This is the fourth year for the award, which is based on the Malcolm Baldrige National Quality Award criteria. Seventeen teams were honored as award recipients. Additionally, more than 100 teams participated in the program through the program's mentoring process, which provided active support by a mentor well trained and experienced in quality. These teams made major advances in improving both



MODERN POWER — Leonard Gragg (left) and Ben Cordova, employees of contractor J&S Electric, work on terminating high voltage cable as part of Sandia's Power System Modernization program. The new system replaces an outdated, undersized network with a modern power grid that allows for future expansion.

their processes and results. (4020)

Safeguards and Security (7400), using commercial systems with customized interface software, has implemented an automated access control system. Video badge-making systems have replaced the personnel-intensive Polaroid system. The new system uses a video image and retrieved clearance data to produce a print-on-plastic badge, encode a magnetic strip, and download access authorizations and update clearance records. Within minutes after entering the Sandia Badge Office, a person has been issued a new badge with access through the appropriate portals throughout Sandia. The reduction of labor and material costs will produce a payback in less than two years. (4900, 5800, 7900, 8800, 8900)

Facilities implemented a cost-effective process for replacing chlorofluorocarbon (CFC) as the principal refrigerant used for large-building cooling systems. The United States ceased manu-
(Continued on next page)

Sandia wins six R&D 100 awards in 1996

R&D magazine cites Sandia work in several disciplines

The Scalable ATM Encryptor

Voice and video transmissions, and any other computerized data, can be kept confidential with a new device that encrypts the data before it is sent and decodes it upon its arrival. The device works between computers interconnected at vastly different speeds, including mainframes and personal computers. It uses standard switching and transmission technology and can be used to send information over the Internet.

The OC-12c ATM Protocol Engine

Supercomputers in different locations can work together as though they were in the same room with a new device that dramatically improves communication between processors. The device uses the same network that the telephone industry provides for national and international communications and is insensitive to distance. With this technology, the only thing preventing the solution of complex problems such as molecular modeling is the number of computers that can be dedicated to the task. The device, designed by Giganet Inc. and Sandia for the Intel Paragon computer, provides many connections through a single interface. The connections make it possible for clusters of processors solving different parts of a problem to share problem-solving results. In tests at Sandia and Oak Ridge National Laboratory, the Protocol Engine was faster than the only competitor in its class.

Integrated Micromachine Technology

A new generation of active skid-control mechanisms for cars and other inertial measurement systems is possible with an innovative technique for fabricating micromachines. By burying micromachines in trenches only 6 microns deep and then chemically removing the protective coating after fabricating control circuits on the same thumbnail-size chip, manufacturers can produce batches of micromachines. These extremely tiny devices will not only shrink the size of critical weapon components — Sandia's primary goal in developing them — they will enable such innovations as vibration suppression systems that smooth rough driving or sensors that track a person's position in three-dimensional environments.

UOP IONSIV Ion Exchanger IE-910 & IE-911

By removing radioactive molecules from waste, researchers can vastly reduce the amount of radioactive material that must be specially handled and kept in long-term storage. Working with Texas A&M University, Sandia scientists have developed a method for removing highly radioactive cesium, a byproduct of nuclear weapon production, from other wastes. Called crystalline silicotitanate, the material reduces the amount of radioactive material to 1/600th its original volume. UOP, an Illinois company, has a license to produce the ion exchanger material.

Sealing Glasses for Hermetic Aluminum Electronic Components

Manufacturers in the electronics industry can now use aluminum instead of steel in combination with glass to hermetically seal components. Until now, aluminum has not been useful because, even though it is lighter, it melts far below the temperature at which glass flows evenly to form a tight seal. Sandia solved this problem by inventing a phosphate glass that melts at much lower temperatures yet does not corrode in water. The new glasses also make reliable hermetic seals between aluminum alloy shells and copper alloy pins.

Low-Temperature, Low-Pressure Process to Produce Aerogels

Large-scale, commercial use of aerogels — arguably the lowest-density solids in existence, comprising up to 99 percent air — is now possible with a new, cheaper, and safer production technique that does not require high temperatures and pressures. The porosity of aerogels makes them ideal insulators for heat, sound, and electricity. Sandia researchers have developed a way to produce aerogels at room temperature and pressure, eliminating the need for expensive and hazardous processes. For the first time, it is possible to prepare aerogels using standard laboratory glassware.

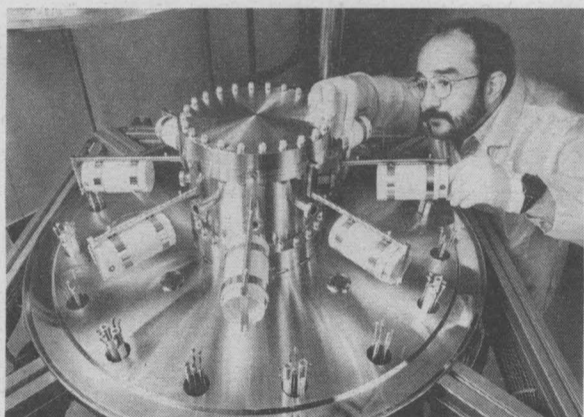
Laboratories support

(Continued from preceding page)

factory of CFCs Dec. 31, 1995. Since the expected life of a chiller is typically 25 to 35 years, the plan was to avoid unnecessary replacement of chillers for CFC phase-out. Life-cycle costing studies were done, and only the lowest cost conversions sufficient to recover the existing refrigerants and build a minimum working inventory were implemented. Future conversions or replacements will be based on refrigerant inventory management and life-cycle-cost minimization. (7800)

The Spend Plan Tool enables project managers to price and verify the accuracy of their budget prior to e-mail transmittal to the appropriate Primary Management Area Office. The goal of the FY97 Spend Plan Tool was to produce a useful, friendly, well-documented tool as defined by the customers. Customer satisfaction trends show an increase over the FY95 Spend Plan Tool. In the FY95 version, approximately 19.9 percent of the project managers were satisfied with the tool. Preliminary results this year indicate more than 85 percent of our customers are satisfied or very satisfied with the tool. To date, the Spend Plan team's customer satisfaction results are equal to those achieved by Hewlett Packard or NASDAQ. (10400)

The Neutron Generator Facility was occupied on Jan. 15, 1996, just four years and seven months after project identification. The average duration for this process is 10 years and 3 months. The project team reduced duration by employing time-saving measures throughout design, procurement, and construction that have since been incorporated into a proposed process that could benefit all projects. In addition to reducing delivery time, this process reduced costs by \$12-\$14 million. The result was a facility delivered a month ahead of schedule and nearly \$2 million under budget. (7900)



THE NEUTRON Generator Facility opened in January 1996, just four years and seven months after project identification, ahead of schedule and under budget.

Under the banner of reengineering, the Controller's organization (10500) has sponsored focused improvement projects in all financial areas. Overall, these projects have realized savings in organizational expenditures of 20 percent, while effecting process improvements with Labs-wide impact, including simplified approval procedures for capital expenditures and employee expense vouchers, improved vendor and employee remittance mailings, and an expedited approval process for vendor invoices. (10500)

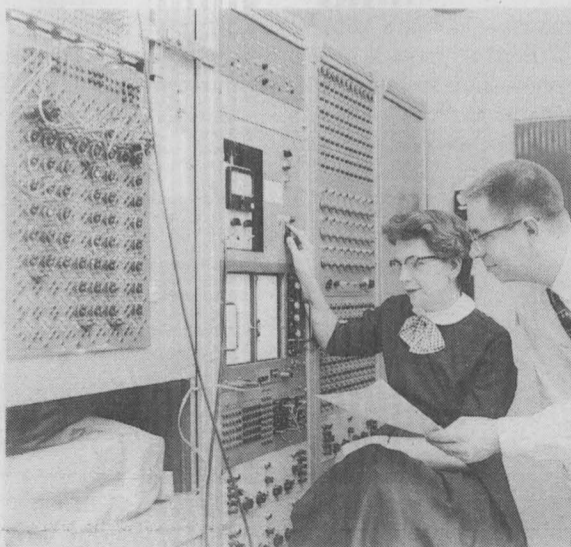
Procurement has substantially decreased both acquisition cycle time and contracting costs by establishing As-Ordered-Agreements (AOAs) with nine major universities (University of New Mexico, New Mexico State University, New Mexico Tech, Stanford, Massachusetts Institute of Technology, Cornell, Wisconsin, University of Texas/El Paso, Oregon State). Sandia can now place "orders" for R&D efforts at these universities in approximately 15 days (versus the previous 54-day average). Further efficiencies were achieved with the University of New Mexico through development of a new electronic method for processing solicitations. The result is many satisfied customers. Significant contributions were made by Organizations 1000, 11400, and UNM. (10230)

The Procurement Organization (10200), in conjunction with Accounting, Finance, Policies and Procedures, Property, and Receiving, has implemented a Procurement Card Program. Under this program, trained and authorized Sandia employees may use a Procurement Visa card to purchase unrestricted commercial products costing up to \$5,000/item and \$10,000/transaction. Program benefits include decreased acquisition cycle time and decreased line customer, procurement, and accounting costs. Customer satisfaction ratings are very high. Annual administrative cost savings are estimated in excess of \$500,000. (10200)

The financial branch of the Sandia Business School continues to maintain its lead role in training and customer support, offering 14 classroom-based courses, implementing computer-based training in four topic areas, and providing manuals, job aides, and consulting on a variety of financial topics, including the Labs' spend plan tool, service centers, use and interpretation of financial reports, financial basics, cost transfers, and purchase order cost forecasting. (10500)

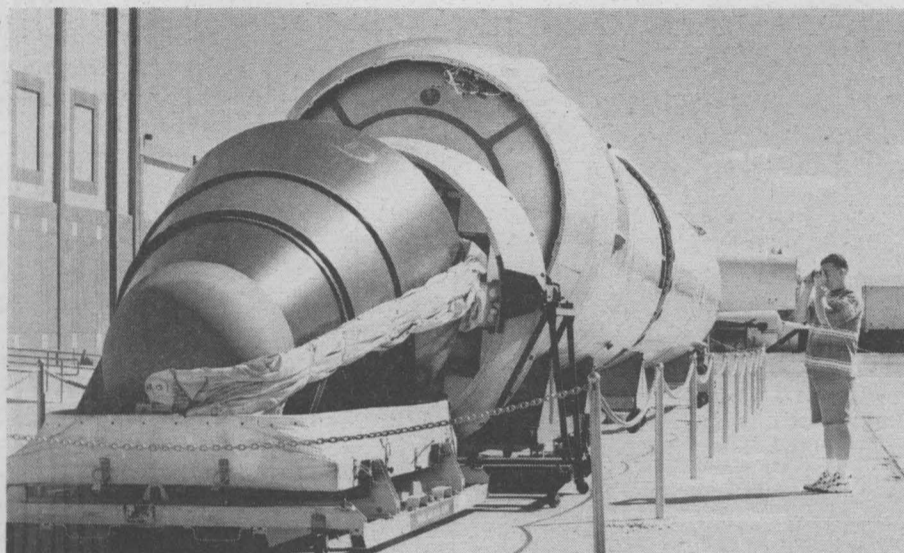
Labs employees fully achieved nine of the eleven FY96 Sandia goals monitored by Lockheed Martin, including, for example, meeting production delivery schedules, continuing to increase the excellence of the Labs' scientific output, and achieving overhead savings of \$20 million or more. One goal concerning measuring customer satisfaction was partially achieved with the establishment of a survey process. The timetable for achieving the last goal, addressing declining Technology Transfer funding, has been extended because of a sharper than expected drop in funding. (12110)

The history and archives programs of Recorded Information Management Dept. 15102 delivered two photo exhibits and a history of Tonopah Test Range (TTR). The photo exhibits, one on the history of women at Sandia and one on the history of transportation technology programs, were displayed at Sandia and at the Juan Tabo branch of the Sandia Laboratory Federal Credit Union. The history of TTR and its people, "Tonopah Test Range: Outpost of Sandia National Laboratories," was prepared with Lockheed Martin corporate funds and printed with funds from Org. 9700. (9700, 15100)



SANDIA WOMAN — A photo exhibit of the history of women at Sandia was displayed at the Sandia Laboratory Federal Credit Union.

On Oct. 1, 1996, the National Atomic Museum completed a major renovation of its weapons display area. The main purpose of the remodel was to arrange the exhibits chronologically and to put the US nuclear weapons program into historical perspective by relating it contextually to societal events. This was done by adding some new historical-reference displays, which were interspersed among the weapons-related displays. New partitions, carpet, and lighting systems were also installed. Long-range plans for the museum include moving it to a new site off Kirtland Air Force Base. All of the upgraded exhibits will also be moved to the new location. (12600)



A TITAN II missile on display at the Sandia-managed National Atomic Museum.

Government Relations expanded its sphere of relationships with federal, state, and local governments through mutual exchanges of information. New or enhanced interactions included:

- 121 congressional briefings, 46 visits to Sandia, and 8 testimonies. Summarization of key Sandia issues for Congressional staff and education of Sandians via a Congressional panel and on-site colloquia.
- Initiation of programs on the national laboratories for New Mexico and California state officials and work with the states on economic development initiatives.
- Strengthening of partnerships with local officials.
- Implementation of a Tribal Government Liaison position. (1, 2, 1000, 4000, 5000, 6000, 8000, 8800, 9000, 10000, 10200, 11000, 12100, 12600)

In August 1996, Public Relations and Communications Center 12600 solicited and received executive approval to implement a corporate "common look and feel" for publicly released communication products. Guidelines were drafted and established in October on the Internal Web to assist developers, and several major communication products, including the External Web graphic banner, have incorporated these guidelines. The "common look and feel" approach promotes Sandia's image as a national security lab, provides a more consistent corporate face to the public, ensures creation of quality products, and generates cost savings by using repeatable graphic treatments instead of potentially costly original creations for every product. (12600)

The records management programs of Recorded Information Management Dept. 15102 established Sandia as the first national laboratory to submit a required site-specific and comprehensive records retention schedule to DOE. The project team members were also major contributors in completing the DOE-wide Records Schedule for Nuclear Weapons. In a related area, the Nuclear Waste Management records manager chaired a working group at the International Atomic Energy Agency on records management processes for deep geologic storage of nuclear waste. (15100)